Feilden's Magazine

THE WORLD'S RECORD OF

Industrial Progress.

EDITED BY

Thos. Feilden

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ANNOUNCEMENTS.

FEILDEN'S MAGAZINE is published at the *beginning* of every month.

In consequence of the large number of pages to be prepared and passed for press, the careful nature of the printing required for high-class production, the advance arrangements made for extensive circulation, and in order to facilitate departmental business, observance of the following rules is necessary :—

Literary Matter to reach the offices not later than the 1st of the month (as much earlier as possible) previous to date of publication. Communications to be addressed "Editorial Department."

Advertisements intended for insertion in next issue must be recieved not later than the 15th of the month (as much earlier as possible), to insure correct classification. All communications respecting same to be marked "Business Department." Advertising Rates, on application, regulated according to positions available.

Subscriptions and letters with reference to copies to be marked "Subscription Department."

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For Buyers' Guide, Index to Advertisers, and Directory of leading British Manufacturers, see pages ii. and iv. of second cover, and pages iii. to xiv. (in first part of Magazine).

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GREAT BIRTHDAY NUMBER OF FEILDEN'S MAGAZINE NEXT MONTH (August issue).

This will be the finest issue of a technical magazine ever issued. Advertisement space is limited and time short. Firms intending to avail themselves of the unique publicity this issue will afford should lose no time in communicating with the Governing Director of Feilden's Magazine.

Subscriptions to Feilden's Magazine which fall out with the current (July) number (first issue of Vol. III.), if received without delay will secure the remaining five numbers of this Vol. (including the splendid Birthday issue) and all the issues of Vol. IV. The present presents an excellent opportunity for those who are not already on our lists to commence their subscriptions. 12s. 6d. (prepaid) includes everything, and ensures the edition de luxe. Subscription forms with special particulars thereon will be found in this issue. Index to Vol. II. sent to subscribers post free for 3d.

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THE EDITOR will be pleased to consider Literary Contributions dealing with subjects within the purview of this Magazine, and to make satisfactory arrangements with Contributors if MSS. be accepted for publication. High-class engravings from photos and drawings will be prepared free of cost to the writer.

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This Issue Commences

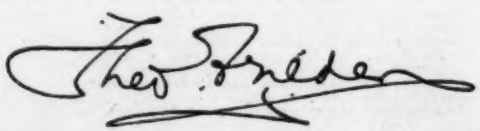
The Third Volume of FEILDEN'S MAGAZINE, and I feel constrained, under circumstances which appear to me to be somewhat unique, to address a few remarks to my numerous readers, who have one and all contributed to the placing of this journal in the front rank of contemporary engineering periodical literature.

I think I may be pardoned for the pride and gratification with which I pen these lines to my good friends in the United Kingdom and beyond the seas, because I am conscious that a great result has been achieved. In twelve short months I have been able to establish in this country, on apparently a permanent and solid basis, a publication which I am assured on all hands is the most useful, readable, and commercially valuable of any issued in Great Britain. This is something for gratification; but lest the uninitiated may determine that it was only for such a journal as this to be launched to command success, let me assure my readers that despite the very hard work which preceded its inception and the chorus of warm congratulation and almost phenomenal support which attended the production of the first issue, it has required since then almost herculean efforts, unremitting attention and the employment of the brains of many competent men, in fact labour, earnest and concentrated, of no ordinary character, and the application of a considerable amount of capital to maintain the standard of excellence and usefulness I set out with, and to arrive at the position the journal now occupies.

Until the advent of FEILDEN'S MAGAZINE this country of ours did not possess a single representative journal wholly and solely devoted to British trade interests, having as its basis the protection and fostering of our great industries and the furtherance of British industrial prestige throughout the world. Whether the task of establishing such a journal appeared to present mammoth difficulties, or whether those hitherto responsible for trade technical literature in this country judged it to be cheaper and better, and therefore more remunerative, to proceed on orthodox lines and to continue to produce what appeared to them to fill all requirements, *i.e.* the dry-as-dust semi-trade catalogue with no defined policy, I do not pretend to say. But what I *do* say is that the need of such a magazine as this, consistently and properly conducted, on honest and independent lines, has been eloquently demonstrated by its receiving an appreciation from British engineers, manufacturers, traders and business men generally, resulting in a sale circulation largely exceeding anything of its kind in the world.

In warmly acknowledging the support accorded the magazine, may I express the belief that I have succeeded in removing the stain which has hitherto been cast upon our periodical engineering literature. Is it too much to hope that the unexampled progress of the magazine and the high esteem in which it is held will be further advanced and intensified? I think not, particularly in view of the fact that no effort or expense will be spared, not only to maintain but increase its sphere of usefulness to British industries the world over.

Next month's issue will be the first Anniversary or Birthday Number of FEILDEN'S MAGAZINE. I anticipate that all well-wishers will unite in a practical manner in wishing the magazine Many Happy Returns of the Day.



A British View of American Competition.

Sir Lowthian Bell has lately written a letter to *The Times*, commenting upon those articles of the current series on "American Engineering Competition" which relate to metallurgical practice. In our last issue we made some reference to the same articles, pointing out the impossibility of drawing comparisons of a reliable nature between American and British methods. At the same time, we expressed the opinion that some of our leading iron and steel works do not fall short of the standard extolled by the special commissioner of *The Times*, except, perhaps with regard to the employment of labour-saving devices which are not permitted by trades unions.

Sir Lowthian Bell is a man whose eminence as an engineer and metallurgist gives considerable weight to any opinion which he may put forward, and it is therefore satisfactory for us to find that in the main he is in accordance with the views stated in this magazine.

So far as practice in iron and steel works is concerned, it appears to us that the correspondent of *The Times* is a little wide of the mark in his criticisms, but there are several points in connection with constructional and mechanical engineering where his strictures appear to be entirely reasonable. Our present object is not to refer to such matters as the latter, but rather to comment upon some of the arguments and statistics quoted by Sir Lowthian Bell. There can be no doubt that our great iron-masters are fully acquainted with the methods of iron production practised in all the more important countries of the world, and we do not think the special correspondent of *The Times* intended to suggest otherwise, as Sir Lowthian Bell appears to suppose. Neither do we think that such as these, "make it a matter of pride to continue in habits of indolence," though an accusation of this sort might be made with some degree of justice against many of our smaller manufacturing engineers.

Sir Lowthian Bell has himself visited the United States, and with an accurate knowledge of the cost of labour at two Bessemer rail works, one of which was shewn to *The Times* correspondent, he has no hesitation in denying the accuracy of the statement that the cost of labour in Great Britain, by reason of faulty appliances and unskilful workmen, more than equals the carriage of the ore from the mines to the Pittsburg works. As a matter of fact the carriage of raw materials to the furnaces greatly exceeds the entire labour of converting pig iron into finished rails. So far as the shipment of ore is involved, the case is cited of "a lofty cliff on the Yorkshire coast, and exposed to the furious waves of the North Sea. Here piers were run out to form a shelter, and upon them hoppers were erected, into which wagons filled with ironstone from the face of the seam, were emptied. Steamers were brought alongside, and the mineral was made to slide into the holds of the ships. In this way 800 tons were loaded in a couple of hours, counting from the arrival of the steamers." This may be fairly taken as a typical illustration that the British ironmaster is not so hopelessly behind the times as some people suggest.

With respect to the question of transit, we commented in our previous article upon the different conditions prevailing in the two countries, and upon the difficulties which are always raised in opposition to any additional facilities for traffic by our own people. For this no one can blame iron and steel manufacturers. Very likely the trucks provided by British railway companies might be improved, but as the vehicles used in the counties of Durham and Northumberland for the conveyance of mineral, represent

the sum of four millions sterling, it is difficult to know who would be willing to pay the necessary price for substituting new trucks. Possibly Americans might effect such an alteration. Probably not.

Sir Lowthian Bell further recalls the point urged by *The Times* correspondent that British methods of transferring material into the furnaces are very raw and imperfect. It is rather interesting to know that the American system was applied at the Clarence works so long ago as 1874, and is in universal use at the Middlesbrough works. Electricity is not employed at Middlesbrough for raising materials to the tops of the furnaces, owing to the unavoidable interposition of calcining kilns between the stores of material and the furnaces, and the report of an American expert brought over specially to advise upon the matter, was to the effect that he could not recommend the adoption of electrical aid.

Concerning the difference between British and American practice in regard to the rate at which smelting furnaces are driven, it is evident that there are two aspects of this question, one financial, and the other technical. Taking the average output of an American furnace at the amount of 2,300 tons weekly, as corrected by Sir Lowthian Bell, and the maximum output of an English furnace at 800 tons weekly, we may say in general terms that the ratio of three to one prevails. Therefore, speaking approximately, one American furnace turns out as much metal as three English furnaces. The life of the former is 5 years, and of the latter 19 or 20 years. If we say 20 years, then, for the production of 2,496,000 tons of metal, four new American and three new British furnaces must be built every 20 years. The American system consequently entails greater outlay for renewals, and besides, the cost of repairs must be heavier. On the other hand, as American furnaces turn out more work, a smaller number of them will suffice for a given duty.

Therefore the initial capital outlay is much less and the area of land requisite is correspondingly smaller. From the financial standpoint, matters appear to be fairly well-balanced, but it is said that an advantage of a technical character is possible when furnaces must be rebuilt every five years, because the ironmaster has a chance of embodying improvements in each new structure.

A great point is made by *The Times* of the fact that the typical American does not want anything to last more than a very few years, for fear lest it shall become obsolete ; but we are by no means certain that the contention applies to blast furnaces, whose essential features are not subject to change as are those of machine tools. Certainly many improvements have been effected during comparatively recent years, but these refer to auxiliaries, which can be applied to existing furnaces without much trouble. Moreover, according to figures quoted by Sir Lowthian Bell, it is not at all clear that Americans are in the habit of improving the build of their furnaces to any remarkable extent.

Taking the average cost of labour per ton in eleven American blast furnaces, and comparing the figures so obtained with those furnished by the same number of British furnaces, we find that the relative cost in America and in our own country is represented by the ratio 2·76 : 1. Possibly the comment may be made that these are extreme cases ; but it is nevertheless evident that perfection is not invariably to be found in the United States. If the statement be correct that the ironstone in Great Britain is poor in quality, and that our coal supply is nearing exhaustion, these are circumstances beyond the control of our ironmasters.

Sir Lowthian Bell, however, doubts whether the ore generally obtainable in the United States is economically preferable to that furnished by the

counties of Yorkshire, Lincolnshire, and Northamptonshire in England; and as for the position of this country in respect of coal, he is inclined to think that matters are not in the hopeless state represented by *The Times* correspondent.

As for the advantages of amalgamation, to which we referred last month, it is interesting to record the fact that negotiations are at the present moment in progress having for their object the reconstruction ot the Patent Nut and Bolt Company, in view of its contemplated amalgamation with the Dowlais Iron Company and Guest and Company. The last-named undertakings, hitherto owned and conducted by Lord Wimborne, comprise collieries, blast furnaces, steel works, rolling mills, etc., at Dowlais, Cardiff, Aberavon, and elsewhere.

The value of these properties is said to be more than £1,500,000, whilst that of the Patent Nut and Bolt Company is £1,000,000.

These figures indicate that Americans have no monopoly in big things; and if this scheme should be carried to a successful issue the new company will occupy an extremely favourable position, possessing its own mines in Great Britain, and an important share in certain Spanish hematite ore mines, being able to produce its own pig iron and steel, and having generally greatly increased facilities for economical manufacture.

Another important amalgamation recently announced is one between the Parkhead Forge Company and the ship-building firm of Napier and Sons, both of Glasgow. The combined companies propose the erection of additional works on the Clyde, at which ordnance, armour plate and other varieties of war material will be manufactured.

Industrial concerns such as those mentioned above do not afford many pegs on which adverse criticisms may be hung. We should like to be able to say the same of every engineering establishment in the United Kingdom.

The Possibilities of the Transvaal.

WHAT are we going to do with the Transvaal? That is the question with which the country is now face to face. Politically, economically, and socially, there is a colossal task before us. Passing over the politics and the sociology as out of our scope, it may not be inappropriate to consider briefly the economic phase of the problem as it now appears, with particular reference to commercial matters and the opportunities offered to British capital. To begin with, when the necessary repairs to the mines have been effected, and labour has been reorganised under the new and better conditions, the output of gold will be greater than ever. This will give an impetus to trade in every direction. The European population of the Rand will probably exceed that recorded before the war within a very short time after peace has been restored. Money will be spent in quantities and will be actively circulated. In a recent conversation which the writer had with a gentleman who has occupied a prominent public position in Johannesburg for some years, and who has made the statistics of the mines a special study, the latter expressed the conviction that within five years from the conclusion of peace the mining industry of the Rand will have doubled its output. Assuming this to be a sanguine forecast, there can be no reasonable doubt that the mining companies will largely extend their operations.

There are particular and technical, as well as general, reasons for anticipating a great development of the mines. The gold deposits of the Rand are distributed over a series of reefs which vary indefinitely in thickness and in the richness of the yield. There is one, the main reef, which averages about 8 ft. wide, whereas the others are under a yard and some only a few inches thick. The main reef

yields something like 6 dwts. to the ton. The others usually much more. Owing to this circumstance and the heavy expenses of working the mines, with commodities at fantastic prices, the main reef has been left severely alone. An honest administration and lower railway rates will make for reduced expenses, and there is every reason to expect that the main reef will be taken in hand profitably. Altogether apart from the likelihood of fresh discoveries, there is, therefore, little doubt as to a greatly increased output of gold.

Cognate industries will derive a twofold advantage from the advent of British rule. The mining companies will be larger consumers and the monopoly system will (it may be taken for granted) be entirely abolished. It would be difficult to exaggerate the importance of this latter condition. The Boer Government have, of course, strenuously denied that they have granted any monopolies whatever other than that of dynamite. Technically they have not. They have only granted "concessions." To take a typical case, the manufacture of calcium carbide may be cited. This chemical, the necessary material for making acetylene gas, was for a time manufactured and sold in Johannesburg at one shilling a pound. But some one obtained a concession for the manufacture from the Government. Sequel, an import and excise duty of one shilling a pound upon calcium carbide was levied on the public in general, with the exception of the concessionaire. Hence the concession became a monopoly. Other important industries have been subject to the same disabilities. It is not difficult to conceive the expansiveness and vim which will animate the industrial and commercial community of the Transvaal when the deadening influence of this rotten system is withdrawn and a healthy scope and verge allowed to capital, brains, and grit.

But a few years back and Johannesburg was a mining camp. Even in Cape Colony very few persons knew anything about the Transvaal beyond the fact that gold had been found there, and that the Boer Republic was grudgingly permitting mining to go on. Even now the British public know little beyond the fact that there is a phenomenally rich goldfield in the country, and that the Boers are much more accustomed to the use of rifles than pocket-handkerchiefs. But the Dutchmen knew what they were about when they settled in this region. The great feature of the Continent is the prevalence of vast tracts of country so arid and so blighted by drought that agriculture is either impossible or heavily handicapped. South of the equator the percentage of land adapted for cultivation and settlement by Europeans is not great. And if artificial irrigation be not resorted to, it must be reckoned at much less. The Transvaal and the Orange River Colony contain together the greatest breadths of rich agricultural and grazing land, suitably watered, and temperate enough in climate for European colonisation, to be found anywhere in South Africa.

So far as the Boers are concerned little has been done in the way of agriculture. The thousands of acres which so frequently constitute a Boer holding are for the most part virgin veldt in the same condition as when the white man knew it not. A few acres round the homestead are usually cultivated, with the aid of oxen and negroes, in a manner unmistakably in harmony with the Old Testament. It is only fair to say there are some notable exceptions to this state of things; but in those instances where Boers have adopted modern methods of farming the enterprise can usually be traced to the direct influence of the Outlander, not necessarily British. Want of water is the great curse of South Africa, and in both the countries under review large portions, at least, are well off in this respect, and nearly all the land is either

naturally or could be artificially irrigated.

Meantime foodstuffs are being imported, both into Cape Colony and the Transvaal. Not merely as a temporary measure to feed the British army, not as the result of any unusual drought, but regularly from year to year as part of the normal condition of the country. Now, in the Orange River Colony the soil is better adapted for grazing than for cultivation, except perhaps for vegetables and certain fruits in the vicinity of such towns as may provide a market. But in the Transvaal there is a great variety of land, some of which, and a great deal of it, is capable of producing every crop of any importance that could be required. In the belt of country lying along the Caledon River wheat can be raised in any quantity. Around Rustenburg maize and nearly all European fruits flourish exceedingly. On the Natal border there is a grand strip of country suitable for horse, cattle, and sheep breeding, while in the centre of the Transvaal and in the northern section sub-tropical produce of nearly all descriptions can be raised in abundance. Cattle will thrive nearly everywhere, but sheep only in such districts as produce sweet grass.

Briefly, then, the position is this—if political quietude can be secured, there will be in the Transvaal, during the next decade, opportunities for British enterprise as great, perhaps greater, than any which have presented themselves in the whole course of our colonial history. In mining and manufactures, and in agriculture, the possibilities are incalculable. Coal and other minerals may yet prove to be quite as valuable in the long run as the gold. As to farming, it is not to be expected that anything like wholesale confiscation of the land will be resorted to, but an indefinite number of holdings will assuredly come into the market. In addition to these, a certain portion of the State lands still unalienated will well repay the expenditure of capital. It is anticipated that a substantial percentage of the volunteers now at the front will remain in the country. Men will not be wanting. The great question is, how far British capital will be promptly and judiciously invested. One thing at any rate is certain : if capital, adequate to the occasion, is not provided by British coffers, it will be forthcoming from other quarters. The pushful American in particular is keenly alive to the resources of South Africa. It is to be hoped he will not get too egregious a share of the benefits.

The British Navy.

THE Admiralty apparently have resolved to set their house in order. The agitation which the Navy League and the public Press has set in motion to provide the Navy with the latest approved guns has at last borne fruit. Mr. Goschen, the First Lord, informed the country, at the annual dinner of the Iron and Steel Institute, that shortly the new patterns of 12 in., 9·2 in. and 6 in. guns would be afloat. And further, a committee, with Lord Rayleigh as Chairman, had been appointed, the reference to which was to carry out trials with a view to ascertaining what were the best smokeless propellants for use in existing small arms, and further, to report as to whether any modification in the existing designs was desirable, with a view to developing to the full the powers of any propellant which may be proposed.

Then there is the water-tube boiler question. Mr. Wm. Allan and Sir Fortescue Flannery still ply questions in the Commons, and the *Pall Mall Gazette* preaches continually of the inefficiency of the Belleville boiler. That there is something wrong with the Belleville boiler there can be no two opinions. The late trials of the *Highflyer* and the *Minerva* in parallel voyages, starting from Gibraltar, have

made it quite manifest that the Belleville boiler cannot be relied on in the same way as the cylindrical boiler to do its work under all the conditions of sea and weather.

The *Minerva* and *Highflyer* are sister ships, second class cruisers, and similar in every way. The *Minerva* is fitted with cylindrical boilers, and her engines can develop 8,000 indicated h.p., while the *Highflyer* is fitted with Belleville boilers and her engines can develop 10,000 indicated h.p. Both have triple expansion engines, but the *Minerva* has three cylinders, while the *Highflyer* has the later four cylinder system of expansion. There were to be three trials at three different speeds, the distance run in each case being 1,000 miles. After the first trial with each at about half speed the Belleville boilers kept the repairing squad busy for a week. After the second trial at still higher speed the Belleville boilers were in pretty much the same condition. But the *Highflyer* did not get through the third full-power trial, and she required a tug to bring her into Portsmouth. The tubes of the cylindrical boilers, after each parallel trial voyage, required only to be swept out.

The *Powerful* and *Terrible* are known as experiments, and it is known also that the *Powerful* took a very long time to return from the Cape. Enormous sums have been spent on repairs to the boilers. Since 15th June, 1897, no less than £10,456 has been spent in repairs to the boilers of the *Terrible*; since 19th July, 1898, £4,218 on the *Diadem*; and since 27th January, 1898, £4,511 on the *Arrogant*. Yet five more experiments of still higher horse-power are being built and they also are to be fitted with Belleville boilers. These are first-class cruisers of the Drake class which have 14,000 tons displacement, 30,000 indicated h.p., and they are expected to have a speed of 23 knots an hour.

The trouble began with the battleships of the *Royal Sovereign* class. These were built with insufficient room for the proper complement of boilers to provide them with steam to give the required 18 knots speed. They made a speed of 15 knots well enough; more than this they could not comfortably go. Later vessels were built of the same type, but with finer lines and consequently less space for the boilers. To obtain the speed required the Engineer-in-Chief was forced to adopt light water-tube boilers, but he did it under protest.

The question then arose as to the type of water-tube boiler to put in. For battleships and large cruisers the Engineer-in-Chief considered that the express type of boiler, with its small tubes of about one inch in diameter, was out of the question. He had no data, in fact no data existed to show that these small tubes would last any considerable time, and it was more than certain that some trouble would be caused by separate tubes giving way. He, therefore, being forced to put in water-tube boilers, decided that only boilers of the large tube type were admissible on battleships and large cruisers.

At that time only one type of large tube boiler had been tried: that was the Belleville on board the Messageries boats. Before this decision the Admiralty had sent an engineer of the name of Eduard Gaudin to run an all-round voyage on a Messageries' boat and to report on the working of the Belleville boilers. He went out in one boat and came home in another, and his report was favourable. We also have reports from engineers who have made these voyages with the Belleville boilers and their reports are also favourable. Anyway the report of Eduard Gaudin was placed before the Engineer-in-Chief, with the result that he decided to try them in battleships and large cruisers. Then came the third-class cruiser of the *Pearl* class. These were fitted with double-ended cylindrical boilers,

11 ft. diameter, and with two furnaces in each end. The beam was 41 ft. These were followed by the *Pelorus* class of much smaller beam, with the result that small tube water-tube boilers only could be fitted in them. Many different types of small tube boilers have been fitted in these, but it is not expected that they will last long. Only two commissions (6 years) is the estimated life of the Belleville boiler, and the life of the small tube boiler is not expected to be so long as this. Cylindrical boilers last about 20 years.

It appears again that the Admiralty is a long way behind other countries in the speed of its cruisers. The *Drake* class, we know, are expected to have a speed of 23 knots, but it will be quite two years before they are ready. But as far back as 1896 and 1897 Messrs. Mitchell and Armstrong launched for the Chilian Government the armoured cruiser *Esmeralda*, which made 23 knots, and the *Almirante O'Higgins*, which made 22 knots. In 1898 the same firm launched for the Chinese Government the *Hai-Chi*, the fastest cruiser in the world, with an indicated h.p. of 1,700, a displacement of 4,300 tons ; she made a speed of 24 knots, and her armament is equal to that of the *Spartiate* class, which has only a speed of 20½ knots. These latter vessels are huge and clumsy, have 11,000 tons displacement, and draw 7 ft. 6 in. more water than the *Hai-Chi*. For the Argentine Republic was built, in 1895, the *Buenos Aires*, with 1,000 tons more coal capacity than the *Hai-Chi*, and she gave 23·2 knots. It will thus be seen that our Admiralty, in design and speed, are quite 7 years behind China and the Argentine Republic. These governments already have cruisers as heavily armoured as our own with higher speed and drawing much less water. They could thus go where our cruisers could not and easily escape anything which we have equal in armour to themselves.

Industrial "Little Englanders."

If one may judge the Little Englander by his public acts and utterances, he is an individual possessing the heaven-born gift of absolute infallibility. He is usually associated with that variegated collection of persons known, for want of a more appropriate term, as the Liberal Party, in which true Liberals worthy of respect and consideration have perforce to rub shoulders with hopeless cranks and time-servers. The political Little Englander, who has a conscientious objection to everything properly calculated to benefit the British Empire of which he is so degenerate a son, is perhaps less able to do mischief than his counterpart who in divers ways exercises a baleful influence upon the progress and expansion of British industries. The industrial Little Englander has many incarnate forms. As the owner of some vested interest, which is of course a most sacred thing, he is ever ready to oppose any new undertaking likely to benefit his fellow-men. As a trades-union official, equipped with a great gift of speech and a small share of common sense, he expounds specious views with much satisfaction to himself and to his unthinking dupes. As a member of the London County Council, or of some other glorified vestry, he advocates the adoption of restrictive conditions intended to benefit the working man at the expense of the manufacturer, but really at the expense of the innocent and long-suffering ratepayer. As a guardian of the poor, he goes out of his way to impose the tyranny of trades-unionism upon engineering and other contractors. He is almost invariably a strenuous advocate of free trade when it will prejudicially affect the British manufacturer, but if he should belong to some elective body he will not have free labour at any price. That would be wicked or worse, for it might diminish his popularity with the working man voter.

The need of our land to-day is a St. Patrick to perform in a moral sense the kind of operation which tradition tells us was executed centuries ago in Ireland. No one can reasonably hope for a miracle of this sort, and those who are interested in the maintenance and development of our position as an enlightened and progressive nation may advantageously begin to think how they can help themselves. Of course, no organisation is conceivable which would be likely to effect a radical alteration in the timidly suspicious treatment accorded to all new enterprises or industries by Parliament. The motor car industry, already in vigorous manhood in some rival countries, is still a toddling infant in our own, thanks to restrictive legislation. Projected railroads, electric railways, tramways and other undertakings, all have suffered and suffer yet from the same cause. Parliamentary Committees seem utterly without an idea of the eternal fitness of things. For instance, if certain people desire to build a new railway which other people would like to use, a committee calls as witnesses the persons directly interested in some rival undertaking. These gentlemen are usually prepared to explain that the new railway is a highly improper affair, that it will seriously interfere with something or other of tremendous importance, that it is hardly practicable, that nobody wants it, and that it cannot possibly pay. Arguments such as these are seriously received, and in many instances they actually appear to influence the decision of the Committee. To show the guileless simplicity of our legislators let us take a parallel case. Suppose it were necessary for a draper to obtain an Act of Parliament before he could build or open his business establishment. Then a Committee would have to be appointed for the purpose of considering evidence for and against the proposed draper's shop. If our present system were adopted, several rival drapers would be called as witnesses, all of whom would doubtless be quite ready to suggest most satisfactory reasons for the undesirable character of any opposition concern in their neighbourhood. Would it be thought proper to be guided by evidence of this transparently interested type? To most people the very idea must seem absurd; yet this or a similar mode of procedure is gravely adopted with regard to other undertakings, and only the elect few are conscious of the humour incipient in the transaction. The Liverpool and Manchester Railway is an example of a useful undertaking suppressed, and largely in consequence of evidence by those interested in competitive companies. We are quite ready to admit that there were features in this particular scheme which required modification, and if the Bill had been referred to the promoters for amendment, or approved subject to certain alterations, we should have nothing to say. Possibly such a course would have been without precedent, and we all know how precious a thing this is, but it is manifestly wrong that any laudable enterprise should be completely and absolutely crushed as was this ill-fated venture, especially when the enormous and unnecessary expense of the reference to Parliament is borne in mind.

When we come to consider the irritating restrictions advocated by trades-unions and supported by local government bodies we see at once the desirability of a powerful union for employers. Unfortunately there is no comprehensive organisation of the kind. Something has been done in this direction, but not enough to enable employers to successfully resist unreasonable demands. In previous numbers we have made references to this question, and we are glad to observe that it is mentioned in an article forming one of a series now appearing in *The Times* on the general subject of "American Engineering Competition." No doubt labour conditions in the United States

are essentially different from those in this country. Here, we have for a long time possessed a superabundant population, and the natural fear has been that the introduction of labour-saving machinery might leave some operatives without work. There, the deficiency of population in the past has naturally encouraged the universal employment of every possible form of labour-saving apparatus, and the habit still survives. American mechanics have, probably, sufficient intelligence to discern that trade increases as a direct consequence of improved manufacturing facilities. This view has not yet penetrated the remote fastnesses of that anatomical detail in which the brain of the trades-union workman is supposed to be placed. As *The Times* points out, "One of the chief advantages the United States manufacturer possesses is the free use of labour-saving machinery: indeed, that and free labour are the foundations of American manufacturing success." Every one who is acquainted with the methods of work prevailing in America or in other industrial countries is perfectly convinced that the home and foreign trade of Great Britain cannot prosper as it should unless trades-unions shall be reduced to their proper status. This will never be done by legislation, for a Conservative Government fears almost as much as a Liberal Government to offend the working man. British manufacturers must help themselves, but unhappily there are no present indications of any universal movement in this direction.

Although we object strongly to their tenets, we must express our admiration for the able and steadfast manner in which some leaders of the men have conducted their campaigns against industrial prosperity. Surely amongst employers there ought to be found some men willing and able to successfully undertake a task similar in nature to one which was not beyond the capacity of comparatively uneducated men.

State Ownership of Submarine Cables.

THE South African war, as well as the recent movement toward a closer union between the Mother Country and the Colonies, has given a new interest to the question of ownership of the submarine cables. If one considers the great importance of telegraphic communication, especially for a country like ours, whose Empire extends over the whole surface of the globe, and, therefore, may be called upon at any moment to protect her rights by force of arms in far distant lands, or to ask for the co-operation of her widely scattered citizens, dwelling in new homes but still belonging to the home of their ancestors whose flag has accompanied them across the ocean, one cannot but realise that the State alone should have absolute control over the telegraphic means of submarine communications, and that private ownership may involve a danger to the interests of the Empire. The question has quite recently been discussed in the House of Commons, the Royal United Service Institution, and the Society of Arts, and the opinions expressed plainly indicated that there is a general desire for fuller State control. There are, no doubt, financial as well as technical difficulties to be overcome; but both Sir Henry Fowler, M.P., whose opinion has the weight of that of a Cabinet Minister, and Sir Edward Sassoon, who, in the House of Commons, as well as in the Society of Arts, brought accusations against the cable companies, made it clear that these difficulties are by no means unsurmountable. At all events, the time has come to thoroughly ventilate this subject, and arrive at a definite policy regarding it, for the ownership of our cables may suddenly become a question of paramount importance.

FEILDEN'S First Birthday Issue next month.

"We are, in the vastness of our possessions, losing our grip on national sentiment. It is our duty to maintain intact, and to defend by sea and land, all that our empire builders have left us. The day that sees the defence of the British Empire sapped, sees the disintegration of the Nation's trade and the hands of civilization's timepiece put back 200 years."—RT. HON. LORD CHARLES BERESFORD, C.B.

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The Flow of Solids . . .

A CURIOUS property possessed in varying degree by many solid substances, is that known as fluidity. It has been defined by M. Tresca as a condition "in which a given force, sufficiently great, would continue to produce deformation, so to say, without limit—as may be observed in the process of drawing lead wire." The particular condition, in which deformation is indefinitely augmented under the influence of a sufficiently great force, is said to constitute the period of fluidity. This period is very marked for plastic substances; it is little marked, or even non-existent, for some vitreous and brittle substances, and in the case of malleable metals it is most clearly developed. In his early experiments with lead and metals of similar nature, M. Tresca noticed that considerable plastic deformation was not accompanied by sensible alteration of density, and he chiefly devoted his attention to a study of the geometrical conditions of the phenomena of plasticity.

In the course of his investigations, it was found that the thickness of the "burr" punched from a block of plastic material, was less than the depth of the hole made in the material. No increase of density took place in the burr itself, therefore part of the metal must have been absorbed into the block. With the object of finding more clearly what took place when metal was punched in this manner, some discs of lead were placed one on top of the other, and the whole pile was punched through. The burr, of course, consisted of a number of discs, the lowest being nearly as thick as the original discs, and the upper ones were thinner. Thus it became evident that the metal flowing laterally into the punched material proceeded chiefly from the upper part of the pile. This interesting subject has lately been discussed at meetings of the Franklin Institute, and one of the speakers mentioned the fact that when some plates, $1\frac{3}{4}$ inches thick, were perforated with a $\frac{1}{2}$-inch punch, the resulting burr was only $\frac{3}{16}$-inch thick, the major part of the difference in thickness representing side flow. It is very difficult to analyse the action taking place under such circumstances. There is no doubt a distinct side movement before any severance occurs, and the remaining metal finally becomes so thinned that its resistance to shearing is less than the pressure exercised by the punch. The quicker the punching process, the less is the flow of metal, and the greater is the power required. Following the same line of reasoning, the power necessary for the shearing of metal ought to be less than that for punching, because the tendency to flow is less restricted in the former than in the latter operation, and, moreover, in the latter, detrusion is resisted by the surrounding mass of metal. As a matter of fact, however, experimental results seem to indicate the existence of an entirely opposite effect. The subject

generally, is one which is not perfectly understood, and upon which very little information is available. Further investigation is much to be desired and would be of considerable interest and value to engineers.

American Iron and Steel Trades in 1899 . . .

THE report of the American Iron and Steel Association for 1899, recently published, is a more complete and instructive document, in many regards, than any of the previous reports. It contains, among other features, full details of the production, imports and exports of the various forms of iron and steel in the United States during last year and the years immediately preceding. There was a remarkable increase of exports in 1899, for their total value, not including agricultural implements, amounted to the enormous sum of $105,689,077, as against $82,771,550 in 1898, and $62,737,250 in 1897. The value of agricultural implements rose last year to the amount of $13,594,524, as compared with $9,073,384 in 1898, and $5,302,807 in 1897. The demand for iron and steel was, as we know, very remarkable in 1899 in all parts of the world, and is well illustrated by the large orders for cars, locomotives, and steel rails placed in the United States in the single month of October. These orders amounted to more than 33,000 from car building companies; about 350 locomotives were ordered from locomotive builders, and the orders for steel rails exceeded 500,000 tons. With exception of a few locomotives these orders were all for local demand. The production of iron and steel and of ores was phenomenal. In 1899 the United States made 13,620,703 gross tons of pig iron, 7,586,354 tons of Bessemer steel ingots, 2,947,316 tons of open-hearth steel, and 10,639,857 tons of all kinds, while they rolled in all 10,357,397 tons of finished iron and steel, including rails. The shipments of iron ore from Lake Superior in the same year amounted to 18,251,804 gross tons, and those of Connelsville coke obtained the height of 10,129,764 net tons. This means an increase in the shipments of iron ore of 4,221,131 tons over those of last year, while the coke shipments increased by 1,669,652 tons. These figures speak more lucidly than comments, and the report from which they are quoted is full of valuable information.

Electricity as a Productive Power . . .

SINCE Moissan first demonstrated the capabilities of the electric furnace as a manufacturing agency, we have seen its application to industrial processes extend with phenomenal rapidity. The use of electric arc in industrial operations, swiftly as it has grown, would probably be more general still were it not encumbered with patent claims, many of which are doubtlessly baseless. Still, as it stands, the electric furnace takes its position, abroad at least, as the nucleus of a very large and important industry.

The action of the electric arc in relation to productive manufacturing operations, is at present little understood. It affords the intensest heat known to physical science. Its action is both decomposing and synthetic, and its industrial applications, save that of a source of heat, is at present confined to two purposes, the production of calcic carbide and carbide of silicon. Its utilisation in these respects were in both instances merely accidental, the product of the reaction being unexpected in each case. Willson discovered carbide of calcium to be produced by the fusion of lime and carbon; Achison, whilst working in quite another direction, produced, by an admixture of sand and sawdust, a substance that would be regarded as a precious gem were it not capable of production in such large quantities; carborundum, otherwise carbide of

silicon, is the hardest mineral known, having an abrasive effect on even the diamond itself, and constitutes an industrial product of no small importance.

The decomposing action of electric currents, currently defined by the term "electrolysis," has been extensively utilised in the industrial arts, and provides in a simple and economical manner chemical products of a purity hitherto unattainable. Here, again, patents of doubtful validity, but whose legal determination must involve immense time and cost, have greatly hampered the progress of the electrolytic industry.

In the consideration of the position and future of the electrical producing industries, one is at the outset struck with the sluggish progress being made in these in this country, as compared with our rivals abroad. We believe the future of these industries to be of the most profound importance; and indeed they are generally recognised as being invested with vast possibilities. Notwithstanding, we see little effort in this country in the experimental study of processes invested with the most far-reaching consequences. We have, in a more or less grudging spirit, accepted electricity as an agent for illumination, and to some extent, power. In its application to these purposes, England is behind all of her contemporaries. We are, however, gradually making up for our lost time, and a period of delay may, in one aspect, not be without its advantages. But in electric lighting and power, the day of the pioneer has gone. We have reached the theoretical efficiency of the dynamo and have little reason to anticipate any organic improvement in the electric light, whether arc or incandescent. But taking electricity as a productive power, we are standing on the verge; we are not even acquainted with the beginning of the potentialities in that direction. There are virgin fields of research before us; let us boldly enter them, and resume the position we held of old, as pioneers in the development of productive industry.

The Cold Storage Trade...

THE traffic in frozen meat suffers no diminution, and there certainly will be a great increase of this trade between Australia, New Zealand, and the Cape. We read of preparations being made in Cape Colony and the building of cold stores being arranged for in many of the Cape towns. At present, however, that business is under a monopoly, but Mr. Rhodes has threatened to run cold stores in opposition to the monopolists. This will certainly cause the prices charged for storage to become reasonable. The expectations held with regard to the trade with this country may be gauged by the fact that the P. and O. Co. are fitting each of their steamers now building with cold storage chambers and refrigerating machinery, and Messrs. Birt, Potter, and Hughes have just had fitted out for the cold storage trade two of the largest ships in the trade afloat. They will each have a capacity of 390,000 cubic feet. Under these conditions and when the trade is advancing by leaps and bounds it is most necessary that the essential facts of the science of the trade should be placed as clearly as possible before those engaged in it. At the late meeting of the Cold Storage Association a paper was read on insulation by one of the chief manufacturers of the insulating material. From the discussion which followed it was by no means clear that good methods of comparing the qualities of insulators existed. In very many of the older liners the dry-air system of refrigeration is in vogue. Yet we learn that about five times the quantity of coal is required to work the machinery on this system than is required in the case of the ammonia or carbonic acid machines. Yet some superintendent engineers prefer this system for several reasons, imperfec-

tions in the other systems it may be. Municipalities are also coming much into the trade. It is now as essential for the Town Council to see that cold stores are provided as that markets are supplied for the use of the townspeople. In view of this, we shall therefore endeavour to place before our readers from month to month a record of the latest improvements to refrigerating machinery and to the improvements in the building and fitting of cold stores by municipalities by private enterprise and on board ship.

The Cost of Power in Cotton Mills . . .

SOME interesting figures relative to the cost of power, as ascertained by the examination of results furnished by a number of cotton mills in the United States, are contained in a paper lately read before the New England Cotton Manufacturers' Association. Two examples of the statistics in question are contained in the following statement.

	(A.)	(B.)
Coal per H-P	$10·60	$11·80
Labour per H-P	2·33	2·57
Oil and Sundries	·32	·80
Depreciation (5 per cent.) ...	3·14	
Repairs (2½ per cent.)... ...	1·57	7·94
Interest and Taxes (6 per cent.)	3·77	
	21·73	
Loss in Engine (10 per cent.)	2·17	
Total per Net Horse Power	$23·90	$23·11

Example (A) refers to a compound condensing engine of 1,050 horse power, the results being obtained by Mr. Webber, the author of the paper, and example (B) comprises data collected by the late Dr. Charles E. Emery. The cost of the plant (A), including engine, boilers, &c., is given as $66,000 or $62·83 per horse power. During 73½ days the following expenditure was incurred; $2,519 for 1,527,000 pounds of coal at $3·70 per gross ton, $555 for labour, $76·50 for oil and supplies, making a total of $3,151, or $13·25 per horse power per annum. According to results obtained from different American cotton mills by five investigators, it appears that the annual cost of power varies with the size of the plant in the ratio stated below :—

100 H-P	...	$63·00	700 H-P	...	$27·00
200	...	45·00	800	...	26·00
300	...	37·00	900	...	25·00
400	...	32·00	1000	...	24·00
500	...	29·00	1500	...	22·00
600	...	28·00	2000	...	21·00

Although the cost of materials, and of labour are not the same in the United States as in this country, the statistics we have quoted are worthy of comparison and examination by those of our readers who are concerned in textile industries.

The Utilisation of Slag . . .

COMPARATIVELY little use has hitherto been made of slag produced in blast furnaces. As a rule, the greater part of this product is employed in the construction of artificial hills which are neither beautiful nor useful, and which, moreover, occupy more or less valuable space; and a small proportion of the total quantity available is utilised in the manufacture of slag-wool. Blast furnace slag is really a crude form of glass, generally opaque, and varying from dark grey to light green in colour. Therefore, it will be seen that slag-wool is a variety of glass-wool, and as a non-conducting material this product has considerable value, though the demand is not sufficiently great to justify the utilisation of more than an infinitesimal part of the slag turned out by the blast furnaces of the United Kingdom. Comparatively small quantities of slag are devoted to the formation of roads and paths, and are used in the manufacture of cement. As the process of iron-smelting involves the use of limestone, ferruginous clay, and poor ores containing aluminous compounds, it is evident that slag

ought to form an extremely suitable ingredient in cement. Although this quality is known and fully recognised by experts, very little cement of the kind is produced either in this or in any other country. Slag-cement is one of the most noteworthy forms of pozzuolana cements, having the property of hardening under water, and the advantage that it does not stain the stone laid by its aid. An improved method in connection with the manufacture of this kind of cement has lately been introduced in Germany and in Belgium; and we may hope that with this example before them some of our British manufacturers will commune with themselves as to the desirability of following suit. A full account of the process is to be found in the Proceedings of the Iron and Steel Institute, where figures showing the cost of production are also given. It is stated that the method in question has been successfully employed for the last three years; and a cement factory is cited whose output is already sold in advance to the end of June, 1901.

The Nicaragua Canal . . .

THE consideration of the Nicaragua Canal question has been referred to the next Congress. Of course, President McKinley could not act otherwise after the American Senate had treated his agreement with Sir Julian Pauncefote, respecting the Clayton-Bulwer Treaty, practically as so much waste-paper, and insisted on amendments rendering it absolutely unacceptable to Great Britain. But what will be the fate of the scheme in December when Congress meets again? Is it probable that, after the excitement of the Presidential election is over, the Senators who tried to wreck the Hay-Pauncefote Treaty will realise that Lord Salisbury, by consenting to abandon the joint protectorate clause of the old treaty, really went out of his way to show his kind feeling toward the United States? We fear not, unless American legislators by that time have made some advance at least in their education regarding international questions. To anybody who judges calmly the problem of the Nicaragua Canal scheme, it must be obvious that the United States could never by themselves prevent the canal from being blocked if any belligerent nation should wish to block it. A single charge of dynamite would suffice to close it to navigation for many months. Very different, however, would be the case if all the great Powers of Europe were pledged to respect the neutrality of the canal as they are pledged by the Constantinople agreement of 1887 with regard to the Suez Canal. In that case, any intending offender would pause before risking a summary retribution on the part of the allied Powers. Quite aside, however, from the misconception that an exclusive political control of the canal by the United States could ever be efficient, one must wonder at the belligerent spirit of the legislators of the great Republic who, in their anticipation of armed conflicts, seem entirely to forget that the primary object of such an undertaking as the piercing of the isthmus is not the construction of a strategical thoroughfare, but of a highway for commerce, and that the latter offers —even if we ignore the over-sanguine anticipations of some of its promoters —so many benefits to all commercial nations, that it would not be difficult to pledge all maritime Powers never to obstruct it. The success of the United States against Spain has, for the time being, rendered bellicose problems fashionable on the other side of the Atlantic; but this fashion will die out, as all others have done, and then will return an era of calmer reflection, and with it a chance of a working scheme being adopted for the construction of the inter-oceanic canal.

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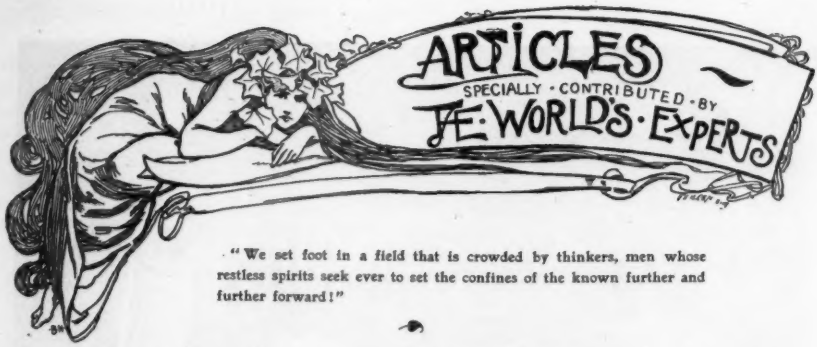
THE PARIS EXHIBITION.—GENERAL VIEW OF THE PALACES OF THE CHAMPS DE MARS.



"We set foot in a field that is crowded by thinkers, men whose restless spirits seek ever to set the confines of the known further and further forward!"

Girder Construction in Small Racing Yachts.

By LINTON HOPE, A.I.N.A.

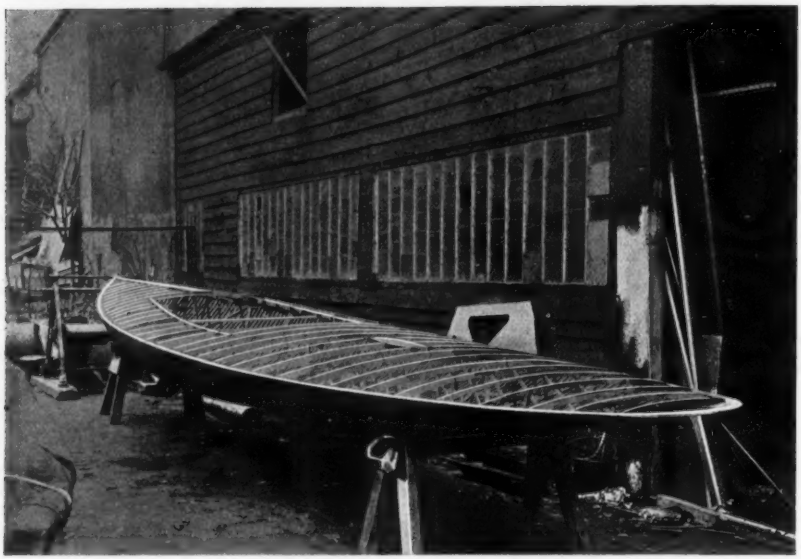
MR. LINTON HOPE has for the past 27 years devoted attention to the subject of boat-building. In 1894 he was appointed manager of the Thames Yacht Building Company, and built the "Sorceress," which won most of the races open to her that year. This was followed in 1895 by the "Lotus," and in 1896 by the "Kismet." The latter boat was built on the girder principle, and out of 45 races sailed won 40 first prizes, 4 seconds, and 1 third.

Since 1894 Mr. Hope has designed no less than 200 boats.

WHEN the yachting public first turned their attention to small yacht racing, about ten or fifteen years ago, all the small racing craft were built on the same principle as they had been for the past century; viz:—heavy oak frames, with timbers mostly sawn out of the solid, and frequently in several pieces butted together.

Strength was always obtained by simply increasing the scantling, without the slightest regard to weight, or placing the strength where the strains came; and in the smallest boat of under twenty feet water line, it was generally considered impossible to build a sea-going, carvel built boat, of sufficient strength to keep her tight; unless she had at least ¾ inch planking, and sawn oak timbers of one inch section or more; though the latter were probably nearly a foot apart.

A few of the more enlightened builders began to see that, for a given displacement, the less weight there



THE "KISMET" IN COURSE OF CONSTRUCTION.

was in the hull and gear, the more they could put into ballast, and so increase the sail carrying power and with it the speed. Then, as the sport became fashionable, and the racing keener, the builders went more carefully into the matter and found that, with equally good design, the lightest boat with most ballast must win. So they proceeded to reduce the thickness of planking and size of timbers, and also began to work in a few steamed timbers of American elm in place of the sawn oak; which was a great step in the right direction.

In lighting the scantling, however, they did not trouble much at first about making better seams in the planking, or to increase the number of timbers as they got smaller. The result was that the boats, many of them, leaked so badly that they could hardly keep afloat during the race, especially while the narrow "plank on edge, lead mine" type was in vogue. The only consolation the owner got was that he wanted speed and must put up with leaks.

About 1893, bulb fins and shallower bodied boats came into general use, as it became apparent that the smaller the displacement, in proportion to length and sail area, the greater the speed became; and that by placing a smaller weight of lead at the bottom of a deep steel fin, or plate, the stability was the same as if twice the weight were fixed to the keel at half the draught on a boat of much greater displacement.

The effect of the alteration in type from a deep-bodied boat of more or less ogee section and large displacement, to a shallow hull of circular section with a deep fin, was to completely alter the strains on the hull, and no one at first knew where the weak places were, till the boats began

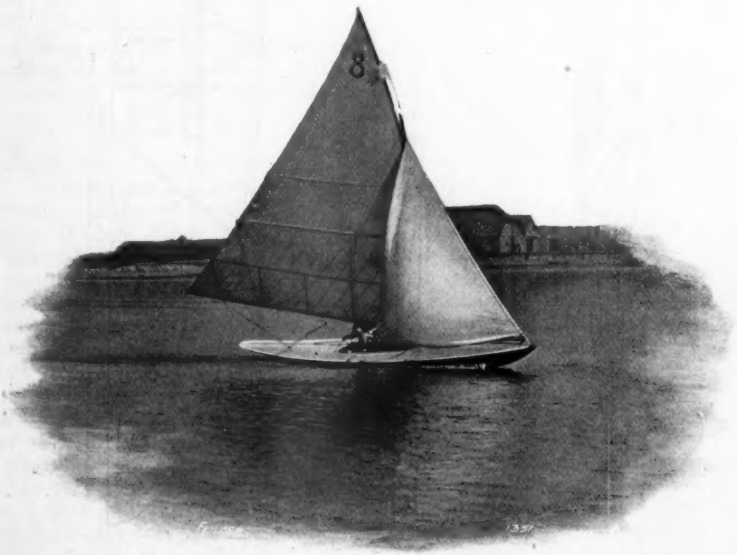
to strain badly and go out of shape, if they were lightly built.

I can remember two boats in particular, one of which pulled her topsides up eight inches at the shroud plates by the end of her first season; and the other (generally known as the "Switchback railway" from her shape after she had raced a few times) pulled up her stern with the fore stay, then her sides at the shroud plates and runners, and her quarters at the main sheet bolts, the end of the counter slightly drooping from its own weight, so it can be imagined that the fair sheer she had when first built was rather spoilt by the end of her very short season. Another crack rater used to come on the slip after every race, when there was any wind, with all her caulking hanging out of the beams.

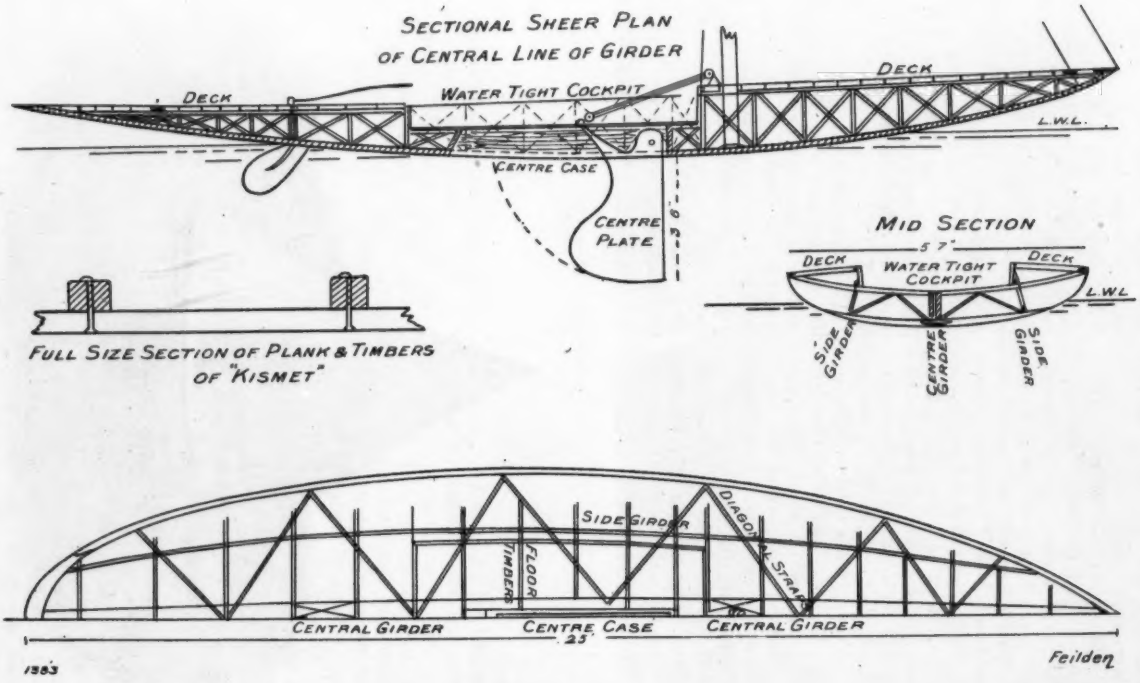
The Upper Thames skiff and launch builders had been turning out some very light carvel built boats of far superior workmanship to any of the Solent boats at that time. They were built on what is known as the "ribband" carvel system, that is to say, the seams had no caulking, but had a ribband or fillet at the back, to which both edges were clinched, with a strip of cloth under the joint, and the nails, instead of being punched into the plank and stopped with putty, were just driven flush with the surface and filed off.

This plan ensured a tight boat of less weight, and with a slightly better chance of keeping her shape; but so long as the boats got shallower, and the old plan of simply using a frame without any attempt at ties and strutts, there was no possibility of a light boat remaining unstrained after a year's hard racing on open water.

The early Herreshoff boats sent over



THE "KISMET."



DETAILS OF GIRDER CONSTRUCTION OF THE "KISMET."

to this country had the first attempt at strutting, from deck to bilges, and were much longer lived than our boats of the same date. In Mr. Howard Gould's 20-rater *Niagara* this principle was carried out to a greater extent with complete success, as I believe she is now as good as ever; while several of our 20-raters built the same year went out of shape and leaked badly.

Since 1894 the writer had been engaged in designing and racing small raters on the Thames and Solent, and had gone to the extreme in cutting away all deadwood and useless weight, even disposing entirely with ballast, and using the crew as ballast on a flat hull with great beam and light, deep, centre plate. Though this was a very bad type of boat for anyone who was not a good boat sailor, they could beat the bulb fin boats almost every time they met. They were not more than half the displacement of the lightest bulb fin boats, and having no ballast, they could be built much lighter as to frame; but the problem was, how to keep them in shape, as in a sea they thrashed a good deal, owing to their flat sections, and the strain of the rigging was as great as in the ballasted boats.

Seeing some diagrams of the ties, &c., in the Herreshoff boats, the writer thought it might be possible to increase the number of them and by using smaller steamed timbers, very much closer together, to get a boat of far lighter scantling than anything that had been built before, in wood. Steel, as a material for such small boats, was quite out of the question, owing to expense and difficulty of keeping from dents, &c., and rust, in such thin plating. Several one-raters had been built of steel but were not at all a success, and as heavy as wooden boats. So far, the lightest ribband carvel boats had been built of at least $\frac{1}{4}$-in. cedar, but in 1895 *Tiger Cat* (the well-known Upper Thames crack) was designed; and she was built of three-sixteenth inch cedar, ribband carvel, as was the half-rater *Lotus*, a sister boat. Both these boats were lighter than any of the others they sailed against, but they were only partially strutted from deck to keel, and had timbers $\frac{1}{4}$-inch and $\frac{1}{2}$-inch, 4 inches centre to centre.

The following year the *Kismet*, 18-linear rater appeared, but it was decided to abandon the ribband carvel system entirely, and to use timbers of half the section ($\frac{1}{4}$-in. × $\frac{1}{4}$-in.) spaced only two inches centre to centre; also to built the boat on three complete lattice girders, running from stem to stern, one along the centre line of the keel and one on each bilge, from a bilge stringer of triangular section running the whole length of the boat on the bent timbers. There were also diagonal cedar straps running across the boat, inside the timbers, but under the bilge stringer and just the same as those used in steel ships.

The seams were carefully fitted "wood to wood," with only a little varnish in them, and were perfectly water-tight.

The total weight of the hull 25 feet over all by five feet seven inches beam, in the state shown in the first photo, was 230 lbs., and when in complete racing trim with a brass centre plate of 150 lbs. she only weighed about four cwt.

The diagram on the preceding page will show the method of strutting with mahogany lattice work $\frac{3}{4}$-inch × $\frac{3}{8}$-inch in section. That the result justified the extra work and expense is shown by the fact that *Kismet* sailed 45 races in 1896 on the Thames Estuary and Solent, winning 40 first prizes and taking a prize every time she started. She also made some hundreds of miles of passages to and from races, often in very bad weather; and at the present time she is still racing on the Upper Thames, perfectly unstrained and water-tight; though of course, now outclassed by newer boats.

Another boat, *Flying Scud*, built for Colonel Paget, was sent to the Mediterranean for the Riviera Regattas in 1897. She was built of the same scantling and material as *Kismet*, but was a larger boat, having seven feet beam instead of five feet seven inches, and carrying 416 square feet of canvas instead of 237 square feet.

This boat had one of the most trying experiences possible for a small boat to survive, as she was towed by her owner's 20-tonner, *Samphire*, from Hyères to Cannes, before a heavy "Mistral." The wind and sea were so heavy that the 20-tonner, though only under a trysail, had to heave to and reef; in doing so, the *Flying Scud*, which had previously been towing easily, was jerked suddenly round under a sea and capsized. The skipper of *Samphire* wished to abandon her, as he said it was impossible to get her righted and no boat could go on being towed bottom up; but the man in charge of the small boat refused to cut her adrift, and she was towed some 20 miles into Cannes. On examining her, to everyone's surprise, she was not damaged in the least, only having torn off a few deck fittings and lost all her loose gear.

There could hardly be a better proof of the efficiency of this style of construction, especially when it is considered that she was a bare three-sixteenths inch in thickness (about half the thickness of a ten foot dinghy), and since then she has raced constantly in Hamburg and Kiel with the greatest success, only being beaten by a later boat of my design.

Since then some 25 or 30 boats have been built on the same principle, and they have all lasted well, though mere eggshells.

Such extreme lightness of construction is not quite so important under the present Yacht Racing Association Rules, as no boat can receive a certificate of measurement unless she is over 15 cwt. without crew on board. As *Kismet* was only four cwt., though the same size as the present boats of 15 cwt., she could not now compete; but the type is still in use on the Upper Thames and Norfolk Broads, and also in Germany, France, and Italy, and the United States.

The larger racing yachts are now well tied and stiffened with steel ties and plate girders on the keel, &c., and all modern yachts are constructed with a view to getting as light a hull as possible with the greatest strength equally distributed where it is required. Though far more elastic than the old boats, they are also infinitely stronger, weight for weight, for, as the size of the vessel increases, it becomes possible to use steel or other metal to advantage in the place of wood, so that a large yacht can be built lighter in proportion than the small craft I have mentioned.

Linton Hope

The Position of Electro-Chemistry.

By H. BORNS, M.I.E.E.

THE Chemist likes to split a body into its constituents. When we wish to examine the development of Electro-Chemistry, we may first take a momentary glance at the electrical and chemical industries in general. That electric lighting has made great strides in this country, though we have heard of awkward breaks down, has generally been conceded in the discussions which the Swiss Réunion of the Institution of Electrical Engineers has called forth. Swiss electricians would find something to learn in this field. Electrical tramways are likewise spreading. But the great power distribution schemes remain in the embryonic stage, and it was just they which might have benefitted electro-chemical industry. The chemical trade of Lancashire and Northumberland has shaken off the depression of late years. Electro-chemistry has little share in the growth, however. There is no particular inducement to push electrolytic processes as long as chemical methods answer well. But we cannot overlook the fact that some such processes have given satisfaction abroad, and it is time we should pass from the probabilities of electro-metallurgy to actual applied electro-metallurgy, which so far exists to a very limited extent only.

To judge by the phraseology of technical, not to speak of scientific papers, and even of patent specifications, the modern electrolytic theories are steadily gaining ground. It cannot be said, however, that their chief advocates are in close agreement, nor that the subject has become simpler within the last years. But it cannot be denied on the other hand that we have got rid of many an erroneous notion, detrimental to sound practice, and that the theoretical controversies have instigated a vast amount of excellent research which cannot but bear useful fruit.

The Electrical Conference, held at Como last summer, in connection with the Centenary celebration of Volta's great discovery, has forcibly brought out the significant fact that we have, in these hundred years, not yet learnt to understand the nature of contact electricity.

That fact sufficiently indicates that the matter cannot be simple. Broadly, however, we may distinguish two parties. The majority, led by O. Lodge, holds a chemical view. The E.M.F. between two metals in contact, noticeable after their being separated, is due to the different degree of affinity of the two for the medium, oxygen as a rule ; it is not necessary that actual oxidation should result ; a kind of polarisation would suffice. The effect should cease in a vacuum ; but as we cannot produce a vacuum, and even by the most careful experiments, such as those described by Spiers this winter, cannot get entirely rid of the gas film on metals, experimental evidence forsakes us. The minority, led by Lord Kelvin, and reinforced at Como by Majorana and others, regards the electric potential as something inherent to a metal as density is, as a direct affinity of metal for metal. Pushed to the extreme, that view would mean in the case of zinc and copper, that not a zinc oxide, but brass is formed, of which we have no proof. Majorana succeeded in demonstrating

the attraction, in the atmosphere, between two dissimilar metals electrified by contact; he failed to show the repulsion of similar metals. But even if he had established both effects, he would not have decided the question.

PRIMARY BATTERIES.

The carbon battery controversy has been renewed by Case. He finds that powdered carbon reduces ferric chloride to ferrous chloride when boiled with it, and also, though slowly, in the cold; that the ferrous salt can be re-oxidised by blowing air into the solution, and that primary batteries can be based upon these reactions. The first observation is new, practically at any rate, the concomitant oxidation of the carbon to carbonic dioxide not sufficiently established perhaps; the re-oxidation of the ferrous chloride by atmospheric oxygen was, of course, known. Though Case has patented a one-fluid and also a two-fluid battery of this type, with powdered or solid carbon electrodes in addition to platinum electrodes, we are very far removed yet from any practical solution of the carbon consuming battery problem. For Case essentially worked with pure carbon, carefully freed from every trace of oxygen under the air pump, and by washing with nitrogen gas, though he also speaks of ordinary carbon. C. J. Reed, who has zealously criticised every carbon and gas battery scheme since the days of the Borchers' cell, objects that the combination could not possibly give more than 0·133 volt, and if Case had found 0·25 and even 0·6 volt under certain circumstances, the E.M.F. would not be due to his reactions. One cannot help thinking that the glass jar is hardly the proper furnace for burning carbon. The experiments with carbon electrodes, in fused nitre, or alkalies—the year 1898 saw several galvanic retorts of deceptively practical aspect—do not progress either. The question of oxidising carbonic oxide gas in galvanic cells by means of atmospheric oxygen in the presence of copper chloride still appears hopeful, but Hoeper's researches do not bring success nearer. Tommasi has made some rather peculiar claims, *e.g.*, reduction of lead peroxide by carbon in salt water. Emanuel's combined galvanic cells and hydrostatic machines or thermo-couples look more like curiosities. In Clark standard cells attention should be paid that the solution remains clear and saturated; when crystals of zinc sulphate are allowed to form, the internal resistance fluctuates enormously owing to capillary action. The Harrison cell, about which a good deal has been written, consists of a lead rod, surrounded with lead peroxide, and a zinc cup, filled with solid zinc amalgam; it is a substantially built cell which leads over to secondary batteries.

ACCUMULATORS.

In spite of the many theoretical papers, the real nature of the reactions within the storage batteries is still disputed or misunderstood. The theory of the reversible element, advanced by Streintz, and developed chiefly by Dolezalek, finds, however, most adherents, and is again supported by Juman, and by Mugdan. The equation, $PbO_2 + Pb + 2\,H_2SO_4 \rightleftarrows 2\,PbSO_4 + 2\,H_2O$, to be read from left to right for the discharge, and from right to left for the charge, summarises the whole theory and signifies practically that the E.M.F. depends upon the concentration of the sulphuric acid, the importance of which feature had, indeed, long been recognised. Jumau thinks that it might be profitable to have a higher acid concentration near the positive plate, if that could be arranged for, and he has rendered good service by demonstrating the deleterious influence of little suspected impurities like antimony, which is not insoluble in the acid as had been assumed, and iron. Manganese salts, acting as injudicious oxygen carriers, are quite out of place in batteries, but are still being patented.

The hygiene of accumulator works is a grave matter which does not receive

sufficient attention. A good deal can be done by aspiration of the air from below, instead of ventilation by upward currents, in addition, of course, to scrupulous cleanliness and prevention of dust. But the lead soldering, for which purpose the lead is heated far above its melting point, is one of the most dangerous operations, which precautionary measures can hardly touch.

No electric plant is now designed without providing for an efficient storage battery, not only for the sake of regulation and of having a reserve, but because it is clearly recognised that a battery means a saving in machinery plant and in working expenses. At the Dunn building in New York, the batteries are put on the top of the seventeenth storey, large cables leading down to the machinery in the basement. The German tram line power stations commanded, in September last, batteries aggregating 13,532 kilowatts, a quarter of the dynamo power of the stations. Since last year the battery power had increased by 167 per cent., although there are very few and only short tram lines, relying exclusively or partly on battery power. Such examples show best the confidence placed on batteries used for station work. Even on tramcars, the accumulators behave fairly well. Frequent partial charging is recommendable. On the Chicago-Harley line, the cells are recharged at the end of each trip, although they could bear the return journey. But on autocars, the accumulators continue to cause trouble, though it may not directly be the fault of the want of reliability of the cells. In London and Berlin, the accumulator cabs and omnibuses make occasional reappearances. In Paris, New York, and Chicago they have not given in. The Automobile Club of Paris arranged for a series of practical, long-duration tests for storage batteries last summer. The conditions were severe, and although the crucial test of how the batteries would behave under mechanical maltreatment had to be abandoned, because the Chasseloup-Laubat machine did not prove strong enough, most of the cells submitted had failed before it came to these final experiments.

We have not succeeded in materially reducing the dead weight of the batteries, and the weight of the batteries increases much more rapidly than the number of car-miles to be made.

The patenting of new batteries and of all sorts of plates and masses proceeds as formidably as ever. Trough or tray batteries still continue in favour, but the plates are not, as before, placed flat, but edgeways. Such ideas seem to spread like epidemics.

APPLIED ELECTRO-CHEMISTRY.

Borchers has compiled some interesting tables on the state of electro-chemical industry, showing that almost every department of chemical industry has been attacked by electricity, but that little ground has been conquered. The statistics are essentially based upon the replies to inquiries addressed to the respective firms, and are, therefore, offered with all reserve. Many firms, of course, declined to answer enquiries. The tables do not comprise galvano-plastic works which employ many hands, though they do not consume much power, nor bleach works, for which two firms, Siemens and Halske, and the Schuckert Co., have each erected plants of over 1000 h.p. The total power available in electro-chemical installations, is estimated at 420,750 h.p., water yielding 378,000 h.p. (in round numbers), steam and gas the remaining 42,700. Much of that power is not fully utilised, however, and we do not know what portion really serves for electro-chemical operations. As regards water-power, France (Savoy, and the Alps, further the Pyrenees, &c.) leads with 110,000 h.p., the United States, and Switzerland following next with 72,300 and 39,000 h.p. When we consider the value of the products, the United States tower above all others with

£40,000,000, the next in order, Germany, not coming up to £3,000,000 per annum. J. B. Kershaw makes the following power estimate :

Aluminium 26,000 h.p. (all water).
Copper 15,000 h.p.
Alkalies and Bleach 42,600 (25,600 water) h.p.
Chlorates 35,400 (32,100 water) h.p., giving a total of 119,000 h.p.

The electrical h.p. can at present produce per annum (Borchers) :

16 tons of copper.
22 tons of silver.
1·6 or 1·8 tons of caustic soda (70 to 80 per cent) plus 3·5 tons of chloride of lime of 40 per cent.
0·5 ton of chlorate of potash.
1 ton of calcium carbide.
0·6 tons of carborundum.

About aluminium, to which we shall refer lower down, the estimates differ widely.

CALCIUM CARBIDE.

Without the aid of water-power, the calcium carbide industry would not have grown so rapidly. Perhaps it has already overgrown itself. Savoy abounds in carbide works, and many of them are, or were, to be enlarged, which sounds ominous. The works of St. Béron, which could turn out 2 tons daily, have been closed, and it is pretty clear that a good many of the works, numbering possibly a hundred altogether, are not manufacturing or not paying, anyhow. It is difficult to arrive at exact numbers, for works take up carbide to drop it again. Only large works with cheap power seem to stand a good chance. But these works, situated in inaccessible mountain districts, have to pay heavy freights before their carbide reaches the market, and that counts as much as cost of production. Hence the longing for carbide produced on the spot, and the renewed proposals for erecting carbide furnaces in peat districts. Yet good profits must have been made by some firms. The cost of production is estimated at about £7 per ton in Niagara and Meran (in Tyrol, Ginand Leleux furnaces, installed by Ganz & Co.) The average price for carbide was last year £14 in Switzerland, £17 in Germany and £20 even at Chedde, in Savoy, close to Chamonix and the Mont Blanc. Very large works are rising at Sault St. Marie (Union Carbide Co.), at Jajce, in Bosnia (Schuckert Co.), Sarpfos, in Norway, &c.

The power necessary for producing carbide is often underestimated. Liebetanz has calculated it at 3·3 kilowatts per kilogramme (1·5 kilowatts per lb.). Ginand Leleux consider 4·26 kilowatts the theoretical minimum, so that 5 kilowatts must be reckoned to produce carbide on a technical scale. That would agree with practical experience; 3 or 3·3 kilogrammes per electrical horse power per 24 hours would probably be a correct estimate, although some firms claim an output of 4 kilogrammes, and even more.

The Cowles furnace patent of 1886 is expiring this year. The dubious outlook and the nullification of the Bullier-Moissan patent in Germany, when the whole question of the carbide "discovery" was fully thrashed out in Court, may have so far prevented others from wasting much money on patent litigation. The patenting craze seems to have passed its climax. But although only strong and simple furnaces have stood the test, complicated constructions, with delicate adjustment of the electrodes, multiple cylindrical furnaces for making carbide cartridges, so to say, &c., are still proposed. Suggestions for the utilisation of the waste heat, a very legitimate idea, are multiplying. Borchers proposes to use two adjacent furnaces alternately, for heating and for smelting, and further to provide a number of furnaces with water jackets which would constantly be under steam. The materials should not be powdered too finely. Otherwise the mass flows too readily and prevents the carbonic oxide from escaping until a big bubble bursts, producing a miniature explosion and causing fresh cold material to fall,

which suddenly puts a very undesirable strain on the dynamos. Birger Carlson recommends pieces of hazel nut size which allow the gas to escape ; there is no object, he thinks, in first pressing briquettes out of the raw materials for the sake of greater homogeneity. The electrodes can be protected by a kind of china glazing or a layer of carbide, dove-tailed into the carbons (Siemens and Halske). At Bellegarde, Langenthal, Meran, Rheinfelden (experimentally so far) and at San Marcello d'Aosta, near Turin, three phase currents are employed directly. At the latter place, the three carbons are grouped so that star or triangular arcs play between them. The hearth of the continuous Memmo furnace rests on a spindle and is slowly lowered. Much trouble has been experienced with the iron carbon holders, arcs forming in and between the holders. Furnaces for interrupted working by Th. L. Wilson are also used at San Marcello. The Horry furnace in use at Sault St. Marie, a kind of short, strong drum with cover plates, turned at intervals about its horizontal axis, is also continuous.

The question of the utilisation of the carbide is as important as the furnace question. Yvon has applied carbide for preparing absolute alcohol, De la Roche for purifying oils ; others have tried it in metal refining, where its action appears to be boisterous. The chief use is still generation of acetylene, and acetylene is not advancing much in popular favour. In this country we have mansions, private houses, and a few small districts (Yorkshire, &c.) illuminated by acetylene. On the Continent, it is much more widely applied, although a new rival has risen in the spirit incandescence lamp, which, ridiculed at first, has already found admission into railway stations (Magdeburg), yards, public halls, &c. For acetylene generation, we want a pure carbide, which we can obtain now. Accidents still occur, though acetylene, capricious like all explosives, will occasionally stand a great deal from the bungler. There was an explosion at the Budapest Acetylene Exhibition, and a gas holder exploded in November in the University laboratory of Pavia. In this case, the explosive acetylene-copper compound was supposed to have formed in the copper vessel, a possibility which Gerdes, of Pintoch's gas works, has denied on the ground of long continued experiments; but the gasholder at Pavia does not appear to have been treated as it should have been. On account of the indispensable purity of the acetylene, Hartenstein's proposals have little chance, however tempting they sound. He draws the molten slag of black furnaces into convertors, and charges it through tuyères with powdered lime and coal.

The Acheson Graphite Co. is erecting works at Niagara for manufacturing graphite from carbide by volatilising the calcium. They are already doing a large trade is carbon electrodes and brushes, and recommend a mixture of graphite and amorphous carbon to painters and for facings and linings. Of the many other products of the electric furnace, we notice the iron silicides of De Chalmot, suitable for electrodes and decorative display, silicon, beryllium, metallic carbides and metals (Moissan, Vigouroux, Williams), phosphorus, sulphur, glass. The reaction has, as a rule, to be interrupted at the proper moment, lest everything be volatilised or turned into some carbide.

ALUMINIUM.

At La Praz and at Neuhausen (Héroult process) the electrical h.p. power is supposed to yield 1lb. of aluminium in 24 hours ; the British Aluminium Co. claims to get as much in 12 hours. If it were simply a question of current tension, Borchers calculates that at Pittsburg (Hall process) currents of less than 4 volts appear to be employed ; at Foyersfall, currents of 4 or 5 volts ; and at Neuhausen of 10 volts. The total production may be 6,000 tons

annually, more probably less. The price of aluminium has kept at 12 and 15d. per lb. The high copper prices have paved the way for aluminium conductors at Niagara; at Chicago, where a 1½ in. feeder has been laid ; in the Rocky Mountains, where miles of wires carry alternating currents of almost 30,000 volts ; and at Rheinfelden, where aluminium bars take the heavy continuous currents from the magnificent hydro-electric station (of 16,000 h.p.) over to the aluminium and carbide works. Several of these aluminium works make also carbide. New uses for aluminium have been found in aluminography, and in the current rectifiers, which have been traced back to Bottome, 1891, and Neyreneuf, 1888. That the aluminium anode becomes covered with an insulating film of basic sulphate has finally been proved by Norden, who, by reversing the current twice, succeeded in making the skin peel from the plate. This sulphate is soluble in free sulphuric acid, which rectifiers should not contain, therefore. In electro-chemical respect, aluminium is already cheaper and more efficient than zinc, and it will, no doubt, find application in primary and also in secondary batteries (Strasser). The Peniakow process, reduction of sulphides, does not appear to advance. The United States patents of Ch. S. Bradley, applied for in 1883, granted in 1892, proposing electric reduction of aluminium on the broadest possible lines, are now before the Courts in the case of the Cleveland Electric Smelting Co. *versus* the Pittsburg Reduction Co. It will be remembered that Th. Goldschmidt succeeded in producing very high heat, suitable for riveting, welding, reduction of chromium, &c., by means of powdered aluminium and a "cherry," containing also aluminium and some peroxide, with a bit of magnesium wire as fuse. This process has been taken up by the Chemische Thermo-Industrie, of Essen. L. Mach has introduced alloys of aluminium and magnesium under the name of magnalium. They are bright like silver, exceedingly light in weight, strong, can be filed and worked like brass, and seem to offer an excellent material for telescope and miscroscope fittings.

GOLD.

According to Henry Louis, the cyanide process, whose origination he ascribes to Bagration, 1842, is spreading in the United States and applied there to telluride ores. In 1897 already one-seventh of the total gold mined, 11½ million ounces, was gained by the aid of cyanides. Three processes may be distinguished. The ordinary cyanidation, suited for the pyritic banket of Witwatersrand, amalgamates first and treats the slimes with cyanide, the gold being precipitated by zinc. The direct cyanidation of Siemens and Halske leaches the crushed ore with cyanide and precipitates the gold on lead sheets ; it is suited for ores in very fine subdivision and very diluted solutions. Louis himself would cyanidate ores, suited for dry crushing, first and let the pulp then pass over mercury or amalgamated copper plates. The Pelatan-Clerici process is used to a small extent ; Pelatan has recently proposed to electrolyse the cyanide solution in his Hungarian mills for four hours, much longer than formerly, and to use picric acid as oxidising agent. Sulman and Teed recommend a solution of KCy and 25 per cent. of BrCy, a very unpleasant stuff to deal with ; the process has been tried at the Deloro Mines in Canada and in Western Australia. Traphagen and Cobleigh observed that the separation of slime and solution in cyanidation was much facilitated by the addition of lime ; this is an old observation of Th. Ellis, however, and not generally applicable.

In separating gold and silver we deposit the silver, because it falls at a lower tension than copper and other metals. But when much copper is present, no pure silver deposit can be obtained. In this case Dietzel and the Scheideanstalt Pforzheim deposit the

copper on a revolving drum, placed over the anode plates with their platinum wires. The lye passes into vats, in which copper precipitates the silver, is freed from iron and pumped back into the first cells. A higher tension is required than in direct silver electrolysis, but a purer silver obtained. Greenawalt proposes to extract the ores with sodium-iron chloride, which is electrolytically charged with chlorine and hypochlorite, and adds one per cent. of bromine.

COPPER.

The copper refineries, which are about thirty years old, afford the most striking example of electrolytic enterprise. Half of the 500 tons at which the daily copper output is roughly computed, is electrolytic. The nine refineries of the United States take the lion share; but the five refineries of the United Kingdom, six of Germany, seven of France, three of Russia, two of Japan, one of Australia, are growing in importance. Last year's trade has been handicapped by an unprecedented rise in the copper prices. December 1898 closed with £56; during the summer the price was pushed up to £77 and £80, and by the end of the year it was still £70. Several large and many small works have taken up the manufacture of tubes and sheet copper after Elmore, Dumoulin, and others. The Elmore companies have amalgamated. Cowper-Coles uses neither hard (agate) nor soft (sheepskin) burnishers, but suspends his kathode vertically and spins it round at 1,000 revolutions a minute, and uses a hot, acid electrolyte (sulphate). All these points are described as essential; the rapid motion throws the hydrogen bubbles off and prevents the formation of excrescences. The Electrolytic Refining Co., of Pembrey, recommends a tin-copper alloy. T. J. Baker, sen. and jun., find that the copper of cyanide solutions of copper and brass is deposited in the cupreous state. Foerster has confirmed several important observations which Von Hübl made in 1888. Small impurities of benzine, varnish, gelatine, etc., are very injurious. He coated a kathode wire with a rubber solution which the electrolytic attacked; the copper deposit was of excellent appearance, but highly brittle. Ashcroft had a good deal of trouble with organic impurities at Broken Hill. The suggestion by Marino, to improve galvanic baths by the addition of glycerine, should, therefore, be received with caution.

ZINC.

In 1898, C. Höpfner read a remarkable paper, in which he claimed to have solved the great problem of the electrolytic extraction of Cu, Zn, Ni, etc., by leaching the ores with hot copper chloride. It was to be done at Papenburg; but nothing further has been heard about the process, and the difficulties of dealing with hot copper chloride in diaphragm cells are sufficiently obvious. It is said, however, that zinc extraction works on the Höpfner plan are opened at Homburg, Hruschan, Weidenau, and Winnington, whilst at Fuerfurt operations have been discontinued. Chlorides are supposed to be electrolysed with revolving zinc kathodes which Tommasi never fails to claim as his invention. Höpfner has patented quite a variety of methods of extraction; he may leach the roasted ores with water and treat the solution with the calcium chloride residue of the ammonia-soda process. The Ashcroft process has been resuscitated in a modified form by W. Hentschel and P. W. Hofmann. The experiments with Broken Hill ores by Cowper-Coles have not been successful. The first reports considered the process satisfactory, except as regards the white lead. Recent reports claim success only for the non-electrical white lead manufacture. Dieffenbach's aqueous extraction of roasted pyrites at Duisburg has been abandoned after several years of difficulties. Siemens and Halske leach with sulphuric acid at

Illawarra, and seem likewise reduced to a non-electrolytic precipitation of zinc oxide by means of magnesia. The Swinburne sulphide process of the Phœnix Parent Co. which stirs crushed, not roasted ores into fused zinc chloride and lead, is favourably commented upon, but has not got beyond the experimental stage. Thus the whole electro-metallurgical extraction remains where it was a few years ago. The only new process which is really a success, the Fry process of the Ellesmere Smelting Corporation on the Manchester Ship Canal, has so far nothing to do with electricity.

H. S. Schultze has, however, solved one problem which is interesting, since there is more belief in fused than in aqueous electrolytes, namely, the puzzling behaviour of fused zinc chloride which gave Lorenz a good deal of trouble. During the electrolysis, gases appear at both electrodes, chlorine and hydrogen respectively; this gas generation continues for hours; the mass then turns dark blue. The trouble comes, as was expected, from the water of crystallisation, which it is almost impossible to expel. Schultze has settled the reactions and finds that if the almost dry chloride is wetted with hydrochloric acid, the electrolysis yields fine zinc crystals. In discussing the merits of galvanizing, Sir W. White declared that the cold electrolytic process of Cowper-Coles required, in the case of boiler tubes, less zinc than the old hot process, and that on the whole both methods might be equally durable. For parts exposed to rough wear he would, however, prefer the hot process. The Cowper-Coles parabolic, palladium coated mirrors have, according to Cowper-Coles, been adopted by the Army, but not by the Navy.

In the preparation of lead white Woltereck has found that it is necessary to keep the solution of ammonium nitrate and bicarbonate cool, and to provide for a good circulation and constantly to draw off and filter the lead white, lest it begin to crystallise. The finest amorphous powder, of course, covers best.

CHROMIUM.

Cowper-Coles claims to obtain good chromium deposits from hot chloride solutions. The oxidation, by means of chromic acid, is effected by Le Blanc and Reisenegger, by the Cie. Parisienne des Couleurs d'Aniline, and by others, in very much the same way, without constantly replenishing the sulphuric acid. The chromium sulphate is dissolved in sulphuric acid, and both the anode and the kathode chambers are charged with the solution. On completing the circuit, chromic acid is liberated, and the sulphuric acid concentrated in the anode compartment, whilst its concentration decreases near the kathode where hydrogen is generated. The anode lye is used as it is, and when returned from the dye works charged into the kathode compartment, whose contents have previously been turned into the anode chamber. The process then begins afresh.

IRON.

The Stassano process, first reported from Rumania, is said to have stood trials in Rome, and three furnaces, each to absorb 500 h.p., are being erected near Bergamo. The iron ore is powdered, passed through magnetic separators, mixed with coal, lime and tar, shaped into briquettes under a pressure of several hundred atmospheres, and broken into large pieces. Iron alloys are also to be obtained by direct smelting.

In electrolysing salt mixtures for the deposition of alloys of iron with nickel or zinc &c., Toepffer made a curious observation. When we raise the tension of the bath gradually, the more noble metal (nickel or zinc) should first be deposited, and when the tension has reached the decomposition pressure of the second metal (iron), both should fall out together, the second metal prevailing as we continue to raise the tension. The first assumption is, of course, correct. But as soon

as the decomposition pressure of iron was reached, the deposit consisted essentially of iron. He worked with rather concentrated solutions.

ALKALIES, CHLORATES AND BLEACH.

The great advance in the alkali trade of Lancashire during the last months of 1899 seems to be largely due to the increased demand for caustic, wanted for mercerising cotton. The price of caustic soda of 70 per cent. has varied between £6 12s. 6d. and £7 and £9; chlorates have risen, and bleach advanced to £6. New processes have not been introduced, and one of the best men, Hamilton Young Castner, has died. The Castner-Kellner Co. has works at Weston Point, near Runcorn, and at Niagara, and is building in Moscow and elsewhere. The Commercial Development Co. has sustained its Rhodin patent against Castner-Kellner in the Court of Appeal, and the American Alkali Co. (Rhodin) is erecting works at Sault St. Marie. The Hargreaves-Bird process will be worked at Middlewich (3,500 h.p.) by the Electrolytic Alkali Co.; the French Company of St. Gobain (also Hargreaves) was floated several years ago already. The Richardson - Holland process is again working at St. Helens. The National Electrolytic Co. of Niagara has adopted the W. T. Gibbs process; the Bay City Works of the American Chemical Co. the Hurter process; the Le Sueur Works at Rumford, Maine, the pioneer electrolytic alkali works, have ceased to supply. The German works of the Elektron Co. at Bitterfield, Griesheim, Rheinfelden, and others are doing well. But the position of the Le Blanc process remains unshaken, in spite of about thirty electrolytic works, and will remain so as long as we want hydrochloric acid. Electrolysis yields chlorine, which is now coming over from Germany in the compressed state; but there is little demand for it. The chlorate of potash production is, however, largely electrolytic, though England has no longer any share in this supply. The nine chlorate works in Switzerland, Savoy, the Pyrenees, and Germany may command more than 30,000 h.p., chiefly water power (also lignite fuel in Saxony), and could satisfy the world's demand. Borchers estimates the annual electrolytic chlorate production at 11,000 tons; half that figure may do. His figures for the production of electrolytic caustic soda of 70 per cent. are 80,000 tons, for caustic potash of 80 per cent. 17,000 tons, and over 200,000 tons of bleach. The bleach industry has certainly assumed considerable importance. The two chief processes are the Kellner and the Vogelsang. The former has been taken up by Siemens and Halske for paper mills, whilst Gebauer furnishes installations for textile bleaching. Prellinger found Kellner's overflow stoneware cells with platinum iridium wire electrodes, to which Kellner has devoted much attention, cheaper than chloride of lime bleaching, although he applied currents of 112 volts. The large installations for bleaching works of the Schuckert Co. of Nürnberg have already been mentioned.

That the chemistry of the electrolysis of alkali chlorides is complicated, is sufficiently clear from long papers by Foerster, Oettel, Wohlwill, and others, who do not arrive at the same conclusions. When chlorates are aimed at, diaphragms are not used, though Blumenberg is reported to prevent, by the application of diaphragms, the hydrogen generation on the kathode, undesirable already, because the fine salt sprays created used, at Vallorbes, to be visible all over the neighbourhood. Octhel has distinguished two chief reactions: (a) alkali and chlorine are first formed, then hypochlorite and chlorate; (b) chlorate is formed directly on the anode by the union of chlorine and oxygen. The reaction (a) predominates in neutral solutions, (b) in strongly alkaline, while both occur in weakly alkaline electro-

lytes. Others consider the chlorate always as a secondary product. The electrolytes should be warm, but not heated above 40 or 50 deg. Cent.; at low temperature perchlorates result. Erich Müller has observed that the presence of chromates, and also of acetic acid, hastens the formation of chlorate; he cannot account for the reactions, however. Sarghel has obtained a better yield of bromates from calcium bromide solutions than from potassium bromide; the coating of the kathode with a crust of lime is, however, troublesome, as Oettel and Bischoff and Foerster had previously recognised in the case of chlorides, and the chlorate of calcium not of much value.

THE ELECTROLYTIC DISINFECTION

by the Hermite process appears to be no longer pushed. The Hermite, Paterson & Cooper patent on bleach is one of those which will expire this year. Whether any of the Woolf installations are really working, is doubtful; but a new plant is said to be under construction in Havana.

THE OZONE STERILIZATION

of potable water, on the contrary, is still occupying many minds, although the cost of ozone production does not encourage such experiments, unless for special purposes. The Tindal plants at Blankenberghe, Oudshorn, and Paris, have been abandoned. E. Andreoli is carrying on experiments, promising to a certain extent, on Thames water with his improved, simple ozonisers, and Marmier and Abraham have induced the municipality of Lille to adopt their ozone treatment. Their accounts are very profuse as to bacteriological tests, but very scanty otherwise. Their electrodes are cooled by water circulation, and the ozone meets the water in a "colonne" about which no particulars are communicated. Kemna has stated that the treatment would cost 2 centimes per cubic metre, which is equivalent to about 0·2d. per cubic yard, but he regards that figure as twice as high as could possibly answer, considering that the water requires a preparatory treatment. At Charlottenburg, Siemens & Halske have made ozone pass up towers against the finely divided stream of water. The Electric Refining and Purifying Co. intends to deal with the Philadelphia water. The Commercial Ozone Syndicate makes a patent medicine and bleaches rhea fibre, while preparing for the flotation of the Oil Refineries and Industries Company. There is no doubt, of course, that ozone could do a great deal, if we could only produce it cheaply and render it more stable.

Moissan's suggestion, to prepare ozone by passing fluorine gas into water, will not alter the state of affairs much, although he has succeeded in decomposing fluorides in copper vessels. He still requires platinum electrode and currents of high tension, 50 volts, and low intensity, 15 ampères, lest the cooled fluorides should become hot.

Verley's ozone apparatus consists of aluminium and silvered glass plates, between which the air circulates in a spiral, and a condenser with a large spark gap which he calls his exploder. They are used for making vanillin, heliotropin, &c., at Courbevoie, which are prepared in a similar way by Otto and others, and in conjunction with Bouillaut at Noyon for sugar-syrup treatment, experimentally at any rate. Caustic soda streams down the coke towers, through which the ozonised air is aspirated. The nitrogen oxides are absorbed by the caustic, and the ozone then passes through the syrup which continues to absorb it for about 1½ hours. The electrolytic treatment of sugar-syrup by means of electrodes of zinc and also of aluminium or lead, in combination with lime precipitation, has proved a success. The Say process, which is worked in Amsterdam by the Wester Refining Company, and in Egypt, is kept secret. Megret makes the syrup circulate in anode compartments with carbon electrodes which dia-

phragms of sail cloth, impregnated with fish glue, tannin, &c., rendered insoluble by means of bichromate, separate from the kathode compartments which contain water and iron electrodes.

Electrolysis finds increasing application in the preparation of various

ORGANIC COMPOUNDS

and especially of colouring matters. As regards the indigo vat, Binz has ascertained that the reduction is due rather to some action of the zinc than to any direct action of hydrogen, and that hence ordinary electrolysis is of little avail ; further researches are required.

The Nordon-Bretonneau process of

IMPREGNATING WOOD

has been taken up by Johnson and Phillips, now the Electric Timber Seasoning Co, of Charlton. The vats contain solutions of borax, soda, and rosin, and the blocks are partially immersed and rest on a grating, the upper free end being covered with felt over which a lead electrode is placed. The treatment requires the application of strong currents (110 volts, 600 ampères) for about eight hours. Electric

TANNING

has been very quiet. It is striking that France, with its important leather industry, has only one electric tanning establishment, that of Worms and Balé in Paris, and that London possesses also only one, that of Groth. Burton is stated to use the electric current for various operations, unhairing, clarification of the lye, &c., and there are, of course, new patents. But the vast electric tanneries, spoken of at intervals, do not appear to have been built so far.

W. Burns.

Great Northern Railway widening between Finsbury Park and Wood Green.

(By Our Special Commissioner.)

For some time past the Great Northern Railway Co. have been hampered with their traffic between Finsbury Park and Wood Green by the fact that it has been impossible to start a train from the Finsbury Park western platform towards Wood Green at the same time that a train left the eastern edge of the platform for the High Barnet Branch.

So that this might be done it has been decided by the Company to alter the line so as to enable two trains to start at the same time in either direction.

Another hindrance has been the fact that there is only one slow down passenger line, so that all the traffic was forced on the fast line during the busy hours of the evening, when slow trains have to stop at each station. It has therefore been decided to provide an additional down slow line, and to effect this object it was necessary to take the existing goods line for passenger purposes, and to lay a new line to the west thereof entirely for goods trains. It will then be possible for four trains to leave Finsbury Park Station at the same time, viz.: on the down fast main line, down slow line, down High Barnet line, and the goods line.

The contract for the necessary works was let to Messrs. J. D. Nowell & Sons, of 28, Victoria Street, Westminster, in December, 1898, who have since been busily engaged in carrying them out.

WIDENING THE BRIDGE OVER THE NEW RIVER AT WOOD GREEN. UP SIDE OF THE RAILWAY.

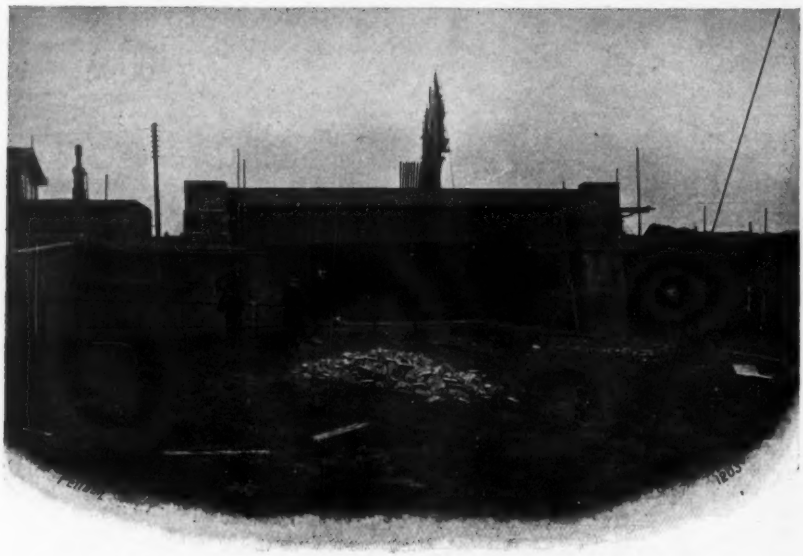
BRIDGE OVER FOOTPATH FROM HORNSEY TO WOOD GREEN.

The contract commences at Finsbury Park and extends to Wood Green, a distance of 2½ miles. The first work of any importance is a bridge under the down High Barnet branch. This has been made wide enough for two lines, so that if another line is wanted in the future there will be no necessity for a further widening. It crosses under the line at a very sharp skew, involving girders of 85 feet span. The abutments of this bridge have been completed, and have been built without in any way interfering with the traffic of the lines over the same, the *modus operandi* being as follows: first large timber baulks were put over the intended abutments to carry the rails; the navvies then commenced to excavate under the baulks to a depth of about 20 ft., timbering the excavation very heavily as they proceeded, and propping up the longitudes as required.

After the excavation was completed they then built the abutments, which are now ready for the girders.

As it is not possible to stop the traffic of the line while the girders are being erected it is intended to put them at the side of the rails, and rivet them together on staging. After this is done the bridge will be asphalted all over to make it water-tight, and the ballast and sleepers will be put in place; possession of the line will then be obtained some night, the old rails will be torn up, and the bridge will then be rolled into place on little trolleys, on a sort of miniature railway. It is expected that this will all be done in a short space of time, as it has been found possible to roll similar bridges of much heavier character into their places, in something like 40 minutes.

The next bridge is under the up High Barnet branch and was carried out in a somewhat different way from the last described. In this case there are two lines over the bridge, and it was possible to divert traffic over one line while girders were put in place on the other.



NEW GIRDER SPAN OVER THE NEW RIVER AT TURNPIKE LANE, HORNSEY—LOOKING WEST.

NEW GIRDER SPAN OVER THE NEW RIVER AT TURNPIKE LANE, HORNSEY—LOOKING EAST.

After the first span was rivetted up, asphalted, and rails laid, traffic was turned on to it, and the other half was treated in a similar manner.

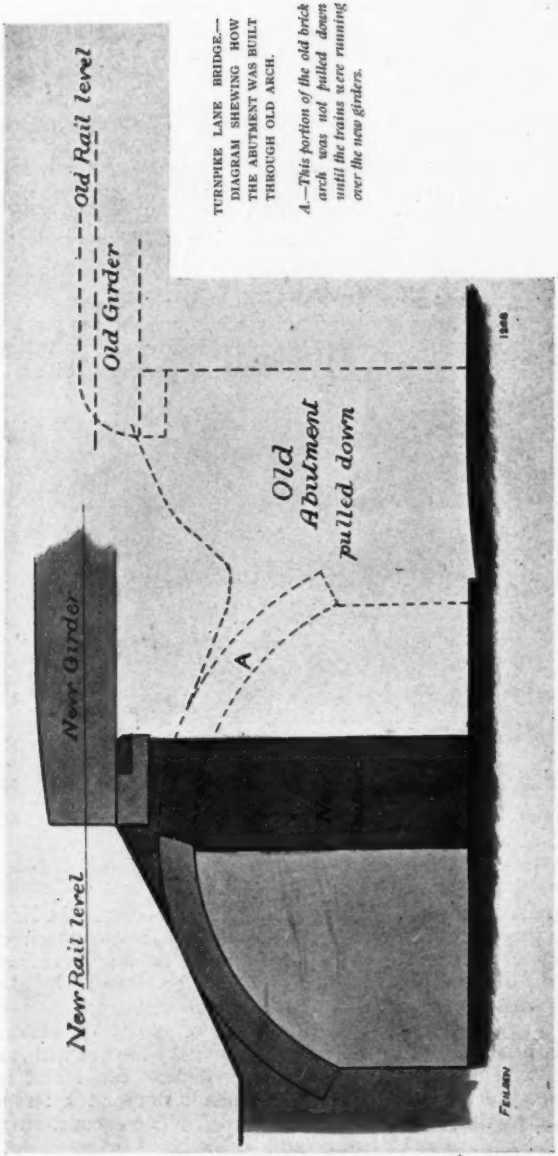
North of the High Barnet bridge is a retaining wall 320 yards in length. This retaining wall is about 15 feet high, and is built of cement concrete, faced with brindled bricks. At the end of this wall is Endymion Road bridge, to which an extra arch has been added to four old ones.

retaining wall 130 yards long, constructed in a similar manner to that already described. From this, following the line a little further to the north we come to Harringay Station, the down platform of which is to be made into an island platform, so that trains can unload passengers from either side. Here again is a heavy cutting, necessitating exceptionally heavy retaining walls. This cutting is at the foot of the hill which is part of the well-known

NEW STEEL GIRDER BRIDGE OVER TURNPIKE LANE, HORNSEY.

This bridge is bell-mouthed in plan, the consequence being there are two faces skewing in opposite directions, and it is rather interesting to note the effect on the radial points of the arch which run out at right angles to the face, then curve round till they are straight in the middle, whence they curve back in the same direction, so as to be at right angles to the other face.

North of Endymion Road is another "Hog's Back," which crosses the North of London. This hill is composed entirely of London clay, and extreme precaution had to be taken in building the wall to prevent it from slipping. This clay is about the worst material which engineers have to deal with, and in this cutting it has been found impossible to make it stand at a steeper slope than 5 to 1. The excavation for the retaining wall had to be done in short lengths and heavily timbered. It



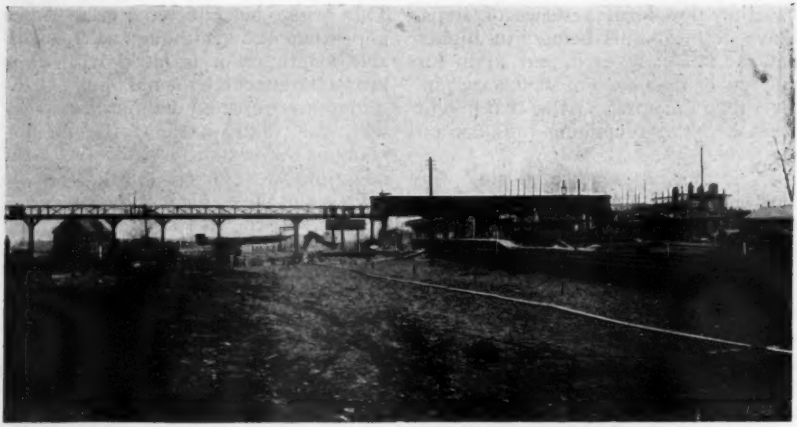
TURNPIKE LANE BRIDGE.—DIAGRAM SHEWING HOW THE ABUTMENT WAS BUILT THROUGH OLD ARCH.

A.—This portion of the old brick arch was not pulled down until the trains were running over the new girders.

is of cement concrete faced with brindled bricks, as already described.

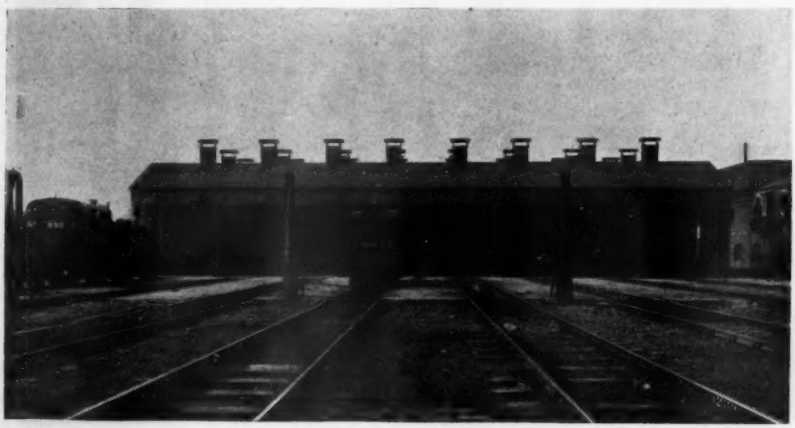
Leaving Harringay Station, we come to the extensive Ferme Park sidings, 26 in number, where the wagons are brought from King's Cross goods yard and sorted into trains to go north. The Company have made an extensive new goods yard at this point to replace goods sidings taken away by the widening. After Ferme Park sidings, we arrive at Hornsey Station, where very extensive alterations are in progress. The down platform is to be made into an island platform, the booking office is to be swept away and put on a new bridge over the line, and the Station Master's house is replaced by a commodious structure next Tottenham Lane.

The present confined footbridge will be replaced by an iron structure 10 feet wide, off which will be the booking office, leading by steps to the up and down platforms. Lifts will be provided for luggage, and every modern improvement will be utilised.



THE WIDENING AT HORNSEY STATION, SHEWING TEMPORARY FOOTBRIDGE.

Following the widening, we next come to a very extensive bridge over the New River and Turnpike Lane. The original structure carrying the railway was a five-arched viaduct with a C.I. girder, span 26 ft. over the roadway, and an arch of 16 ft. span over the river. The river span has now been replaced by girders of 32 ft. clear span, the old arches have been filled up with earth, and Turnpike Lane is now crossed by steel girders of 50 ft. clear span. There are 17 girders in all crossing this road, and, as (owing to the inclined roadway below) the old girders only gave 14 ft. headroom at the west side, and the Company were required by the County Council to give 16 ft. headroom, it was necessary to lift the girders at the west end of bridge, so



NEW ENGINE SHED, HORNSEY.

that they now form a series of steps, the westermost rails being 7 in. higher than the rails next to it, and so on for four sets of rails, each of which are 7 in. lower than the other. After that height is reached the remaining rails are on one level.

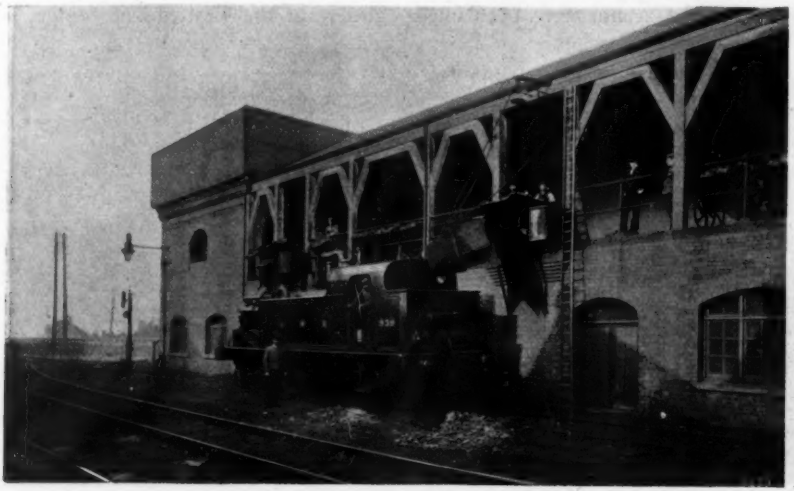
An interesting feature during the construction of this bridge was that the south abutment had to be built down the centre of the old arches, and it was necessary to keep this old arch up for some time to build the abutments through it, so that the girders might be fixed to carry the railway, before the old arch was pulled down. This somewhat difficult work was carried on by cutting holes in the arches at intervals, and building the abutment through same, taking the thrust of the arch at the back and front.

After this was completed the abutment pierced through the whole arch, taking the thrust as described.

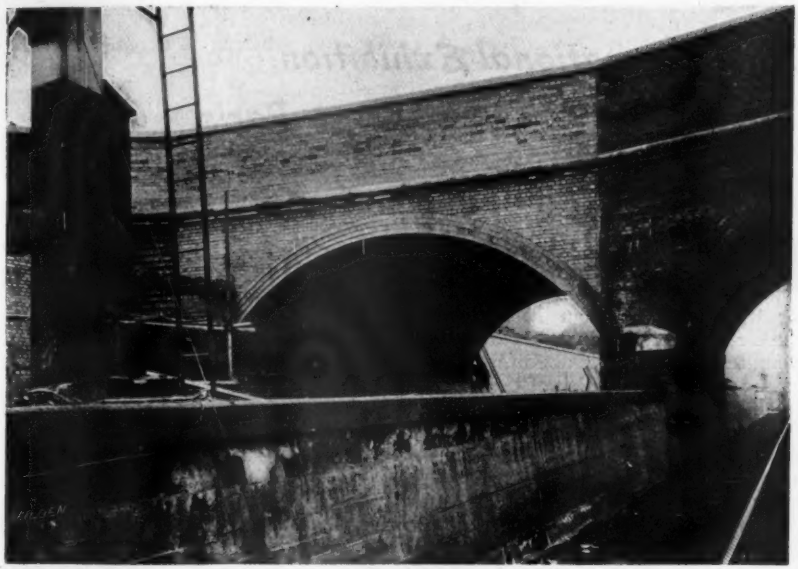
When the girders were erected so that trains could run over same, the arch next the roadway was removed, and the face of the abutment made up. This bridge has effected a great public improvement, and although of considerable length, as it is faced with white bricks, the effect is light and open. All the girders were erected without interfering with the railway traffic, the method being as follows :—The girders for the new line were fixed on the west of bridge, and the traffic was then diverted over them ; the girders were then fixed on the site of the diverted line, and again the traffic was turned over it, and so on throughout the bridge. When the whole bridge was completed the lines were slewed back into their original position, one road being done each Sunday.

Going further north there is not much to attract attention till we get to a small girder span under the railway, which is being widened about 70 ft. The old structure was a three-arch bridge of 25 ft. span each, but this will be altered into one arch of 15 ft. span, faced with white bricks.

Going still further north, we come to Wood Green Station, where the widening terminates.



NEW COAL STAGE ON THE HIGH LEVEL, HORNSEY.



BELL-MOUTHED EXTRA ARCH ADDED TO ENDYMION ROAD BRIDGE, DOWN SIDE OF RAILWAY.

Hitherto we have only described works on the down side of the line, but there have been very extensive alterations on the up side, one of which is the bridge over the New River at Wood Green. The existing bridge is a single brickwork span of 20 ft., but by requirements of the New River Company the span had to be 40 ft. in width.

It has been decided that this bridge is to be widened for the whole length of the Company's property, so it is being made 245 ft. longer than at present. The length is covered with steel girders and flooring, all of which is rendered watertight by asphalte.

Very extensive carriage sidings and goods sidings are being constructed at Hornsey, and, when completed, there will be sufficient standing room for 285 carriages. Opposite Hornsey Station, on the up side, a large new engine yard has been constructed. The engine shed will hold 30 tender engines, or 40 tank engines, as the exigencies of traffic require. There is also provided a 52 ft. turntable; this is being made sufficiently long to accommodate the largest locomotive in use on the Great Northern Railway, of which the new engine, No. 990, is a type. To the east of the engine shed is provided a new coal stage on a high level, thus enabling coal to be shot directly into the tenders instead of the old fashioned way, when coal had to be lifted from the same level as the engine was standing on. This coal stage is approached by rails having a gradient of 1 in 20, and sufficiently large to accommodate seven wagons.

The works have been carried out under the direction of Mr. Alexr. Ross, M.Inst.C.E., the Chief Engineer of the Great Northern Railway Company, by Mr. H. W. Sadler, M.Inst.C.E., the Chief Assistant of the Construction Department, Mr. F. Gregory being the Resident Engineer.

C.E.A.

The International Exhibition at Paris.

By Professor Jacques Boyer.

By a decree, dated July 13th, 1892, the French Government decided to adopt in principle the motion for the opening of an International Exposition at Paris in the year 1900. Definite administrative action was then taken for the organization of the various details and by a bill, passed on June 13, 1896, the necessary funds were voted and placed at the disposition of M. Alfred Picard, the General Commissioner, in order to enable him to bring to a successful issue the gigantic undertaking in which so many millions have been invested. Eminent and devoted assistants, such as M. Bouvard, an artist of unerring taste, MM. Grison and Delaunay-Belleville, gentlemen of business-experience extending over many years—to mention merely the most important names—gave him their valuable aid, and, after having for more than four years broken up and made chaos of the most elegant quarters of Paris, after having thrown bridges and foot-ways across the Seine, and built palaces laden with gold, sculptures and marble, the engineers and architects of France invited the civilised nations of the globe to display within the walls of this Babylon of a day, the treasures of their industry. If the date of the official inauguration, the 14th of April last, was, perhaps, somewhat prematurely chosen, the exhibitors, at all events, have made up for the unfavourable impression produced through this mistake by the marvels they have unveiled before our eyes. Let us, then, give a rapid outline of those structures of which in a few months there will remain nothing but the memory.

Before doing so, however, we may mention a few statistical data. The total area of this new "World's Fair" is considerably larger than that of the preceding Exhibition, for it comprises, in round numbers, 1,080,000 square metres, of which 460,000 are covered with buildings, while the Exhibition of 1889 comprised only 960,000 square metres of which hardly as much as 290,000 were devoted to buildings. Situated in the very heart of Paris, the new Exposition occupies, in the Champs Elysées, the site of the Palais de l'Industrie built in 1875, but since destroyed to make room for two far more imposing structures; it then spreads over both banks of the Seine, extending between the Place de la Concorde and the Pont de Jéna, and finally comprises the Champ-de-Mars and the Esplanade des Invalides. It is enclosed on all sides by palisades painted in light green, decorated with festoons and trellis-work, the enclosure having numerous gates to give easy access to the visitors.

THE MONUMENTAL GATE.

Let us enter through the monumental gate (see Fig. 1), situated at the beginning of the Cours de la Reine at one of the corners of the Place de la Concorde. It consists of three great arches of 20 metres' span forming a triangle and supporting a hemispherical cupola. A pretty fronton covers the principal metallic truss, and the ship, the symbol of Paris, on the prow of which is crowing the Gallic cock, stands out as chief architectural motive of the middle portion. A statue

by P. Moreau-Vanthier represents a sprightly daughter of Paris, the "City of Light," receiving her guests. Two minarets 35 metres in height, placed at the right and left of the structure, are joined to the central arch by two great curved walls, 9·30 metres in extent and 2·20 metres in height, of "flame-coloured sandstone" ("grès flammé"), *i.e.*, yellowish grey stone, furrowed with reddish streaks. Upon this background, devised by the sculptor

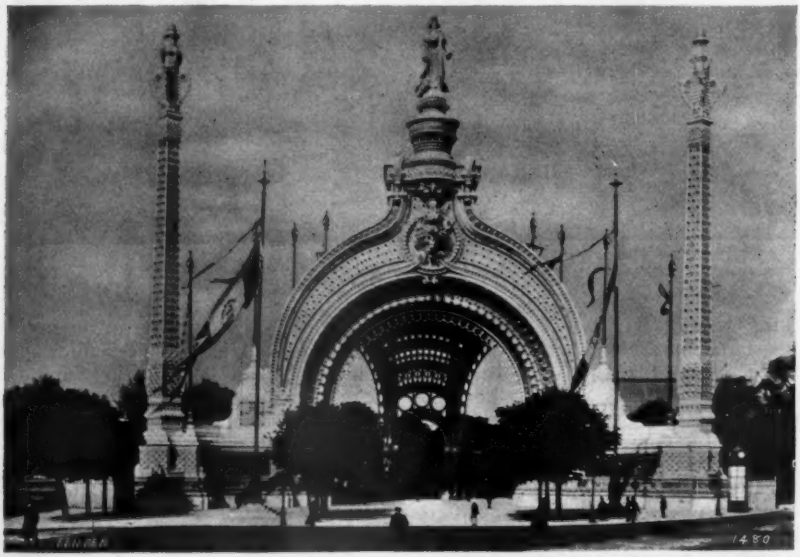


FIG. 1.—THE MONUMENTAL GATE.

Guillot, we see defile before our eyes all classes of workmen; the carpenter, the husbandman, the electrician, the painter, and the smith come to contribute their share to this gigantic festival of Labour.

The skeleton of the building is constructed of iron covered with wood which, in its turn, is covered with *staff*. As this method of construction has been adopted in nearly all the other buildings of the Exposition, excepting the Palace of Fine Arts, a slight digression may be permitted in order to show in what this new process consists. *Staff* is nothing but a combination of packing canvas and plaster, and it serves advantageously as a substitute, as far as solidity is concerned, for the ordinary plaster casts. Its employment offers no difficulties. The first thing is to get a hollow mould of the object which is to be reproduced and to grease or oil it, so as to render easy the removal of the cast. The next is to pour into the mould liquid plaster to form the outer surface of the casting. Then before the plaster has become quite solid, pieces of canvas soaked in plaster are pressed into the mould, which, combining with the still moist outer layer, form a compact and intimately mixed crust, about 1 c.m. in thickness. Finally, in order to give still greater solidity to the casting, it is supported by small wooden

FIG. 2.—THE PALACE OF THE FINE ARTS IN THE CHAMPS ELYSÉES.

rods, forming the inner skeleton of the statue or architectural design reproduced; and after having carefully attended to all these details, there remains nothing but to remove the cast from the mould. For the more important plane surfaces required in the structures of the Exposition, instead of the hemp or canvas, suitable for stiffening plastic work of minor dimensions, a more solid material has been employed to cover the woodwork and, according to circumstances, either "expanded metal," a kind of metallic net-work, recently invented by M. Golding, or cane trellis-work, or even nets of stiff and strong cords have been selected.

Let us return, now, to the Monumental Gate. In its entirety it resembles a dome recalling the Hispano-Arabic style of certain mosques. Under the cupola, below which the public enters, 36 wicket-gates have been ingeniously placed, for the control of the admission tickets, running from the pillar on the right to the pillar on the left, and completely surrounding the edifice. The little boxes in which the ticket-controllers sit are devised in such a manner as not to be in the way of the entering or leaving multitude of visitors, who can be admitted into the enclosure at the rate of 60,000 to 80,000 persons per hour. There is no danger of a crush, at all events, near this gate of the Exposition.

The general colour of the structure is white, relieved by polychrome decorations, the blue, red and gold tints of which are so loud and Byzantine in their effect as to do little credit to the taste of M. Binet, the architect. Still, at night time, when the powerful electric lights that surmount the pillars are turned on, and the 3,116 incandescent and arc lamps are ablaze, throwing radiance upon every portion of the gigantic portal, the nondescript style is forgotten over the fairy-like spectacle.

THE PALACES OF FINE ARTS IN THE CHAMPS ELYSÉES.

On leaving the Monumental Gate the spectator sees before him a beautiful avenue bordered on either side by trees and gardens, which French gardeners and nurserymen have laid out in good taste. More than 500 species of trees and shrubs are represented in the various groups, without counting some hundred climbing plants and ornamental flowers which will be renewed twice during the time that the Exposition remains open. In the midst of the beautiful flower-gardens laid out and designed by worthy successors of Le Nôtre, fountain basins send upward slender sprays of water and waft across to us a delicious freshness; and the verdant thickets we behold are those which surround the two principal edifices of the Champs Elysées, both permanent structures, which by themselves have cost more than 25 million francs.

In front of us we perceive the Little Palace of Fine Arts, which occupies an area of 7,000 square metres. Its architect, M. Girault, has made very clever use of the trapezoidal section of ground forced upon him. The great facade of the building faces the Avenue Nicholas II., lying in the prolonged axis of the new bridge dedicated to Alexandre III. Its semi-circular porch is surmounted by a dome. Two pavilions with triangular frontons form the end of the edifice, and thirty-six columns ornamented with Ionic capitals rise from the base. At the right and the left from the principal entrance, statues are placed between every pair of columns. Besides, there are three large semi-circular colonnades placed into recesses of the terminal pavilions. The lateral portions of the edifice contain windows alternating with niches which will later be filled with statues; and around the whole top of the building runs a balustrade in order to disguise

FIG. 3.—THE ALEXANDRE III. BRIDGE.

the roof. Upon entering through the grand portico, we find ourselves in front of a staircase leading to the vestibule, surmounted by the dome. From there one passes into a semi-circular court surrounded by a high colonnade, behind which runs a circular gallery leading at one end to lateral halls, and at the other end to two pavilions in the form of rotundas. This is the edifice devoted to the exhibition of the masterpieces of French art, from its beginning up to 1800.

On the opposite side is the Great Palace of Fine Arts which, though of a somewhat mixed style of architecture, still rises majestically and grandly before us (Fig. 2). This building, constructed after the plans of MM. Deglane, Louvet, and Thomas, has the shape of an I with unequal cross branches, and covers a surface of 40,000 square metres. A massive colonnade ornamented with oak and laurel branches completely surrounds it. The peristyle of the chief façade consists of three monumental entrances, and on each side are four statues. On the right are allegorical figures of Sculpture, Painting, Architecture, and Engraving; on the left are represented Egyptian, Greek, Roman, and Byzantine art. At the back of the great colonnade, the great epochs of art are illustrated in polychrome mosaics. In the body of the building, parallel with the Avenue Nicholas II., is a large glass covered hall. Another gallery, perpendicular to it, and leading into it in its middle portion, connects it with the portion of the edifice which runs alongside the Avenue d' Antin. This section comprises a great central nave and halls in the wings which have two stories each. The ground floor is at a higher level than that of the vast central halls, and its promenade galleries, in the shape of porticos, will, after the Exposition is closed, serve as tribunes from which to witness the horse races. Monumental

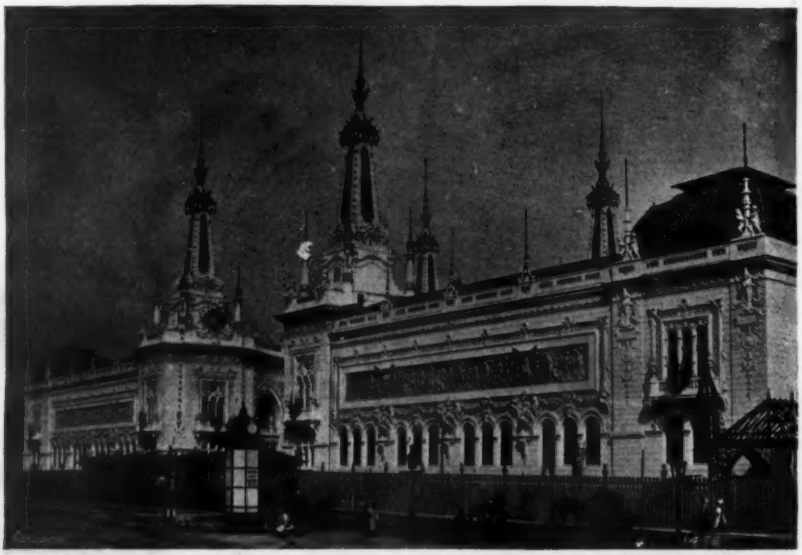


FIG. 4.—THE PALACE OF THE ESPLANADE DES INVALIDES.

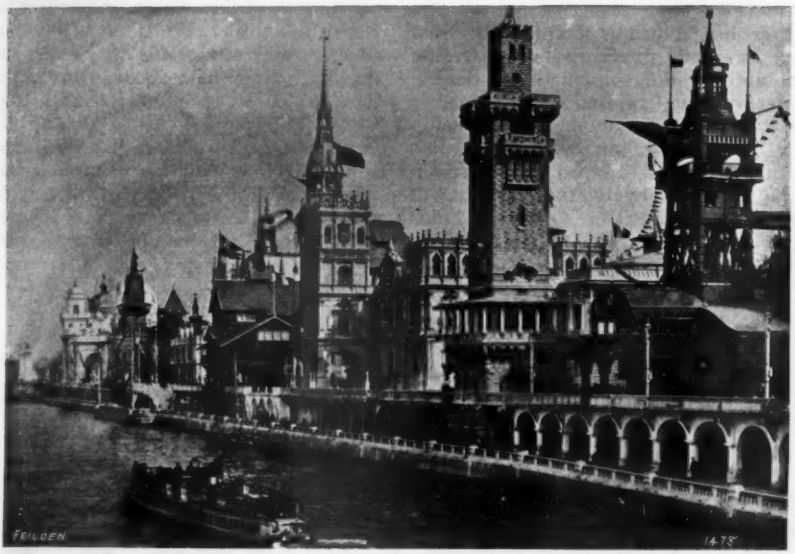


FIG. 5.—THE RUE DES NATIONS, AS SEEN FROM THE PONT DE L'ALMA.

staircases connect the various portions of the edifice, which receives its light through a glass roof. To say a word with reference to the construction of this roof, which is an interesting work, both as regards the weight of the iron introduced (more than 6,000 tons), and the short space of time in which it was built, it may be stated that this roof in its entirety comprises a great dome 70 metres in diameter, supporting a smaller cupola 7 metres in diameter, from which rises a campanile 18 metres in height, the highest point of the building being 75 metres from the ground. All the trusses belong to the type known as *fermes encastrées, i.e.*, in other words, the resultant of all the lines of stress passes through the points of support to the ground. A great mass of iron cramps, buried in concrete (béton), supports this pressure so well that the walls of the Palace themselves have not the slightest portion of the weight of the roof to bear.

As regards the style of this building, which contains the most valued masterpieces of contemporaneous artists, it is difficult to define it, since Roman, Renaissance, Louis XIII. and Louis XIV. go, so to say, hand in hand ; but the whole impression is imposing, and that suffices.

THE ALEXANDRE III. BRIDGE.

The new bridge named in honour of Alexandre III., the present Czar, which had been included in the programme of work to be executed for the Exposition, unites the Champs Elysées to the Esplanade des Invalides (Fig. 3). It was designed by two engineers in common, MM. Résal and Alby, and crosses the Seine with a single arch, having a span of 107·50 metres. It belongs to the three-hinged arch type with viaduct approaches. The platform rests by means of vertical beams upon fifteen arches of cast steel, hinged at their springings to pans. Each of these arches consists of a number of wedge-stones

connected by means of bolts. The triple hinge insures a satisfactory distribution of pressures, renders the stability of the construction independent of temperature, and diminishes very notably the momenta of flexion in the neighbourhood of the key. The bridge carries a highway 20 metres in width flanked by two footways each of a width of 10 metres, so that it holds the record for width. The fitting of

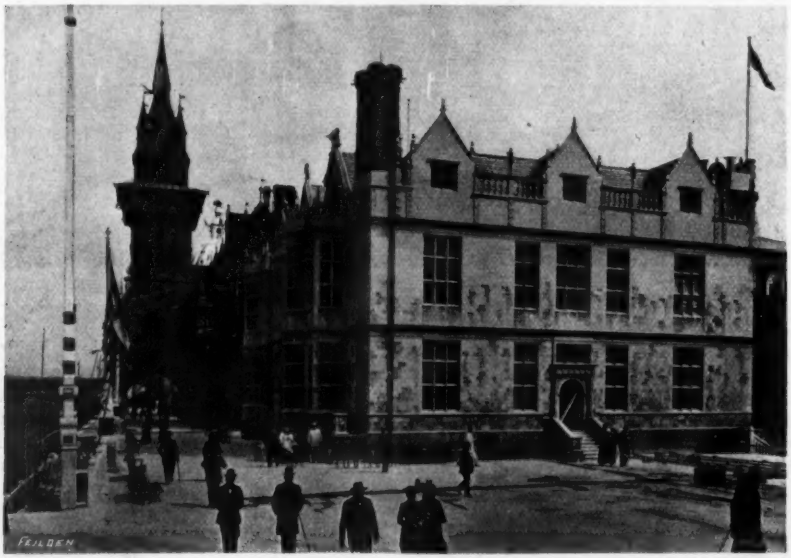


FIG. 6.—THE BRITISH PAVILION.

the various pieces of metal was managed in quite a remarkable manner, since it was accomplished without interfering with the traffic of the vessels on the Seine. The engineers succeeded in doing this by throwing across the river a footbridge supporting the platform on which the labourers worked and cars ran on a track laid in the centre, which brought the arch-stones to the very spot where they could be placed in position. The architectural character of the Alexandre III. Bridge is in every way worthy of the neighbouring palaces. Near the entrance the side walls widen so as to make room for the staircases leading below. The decorative details, due to MM. Cassien-Bernard and Cousin, include two great pylons, on either end of the bridge, built of square stones. Their height is 12 metres, and they are surmounted by allegorical groups representing Fame and a Pegasus in bronze. On each corner of the pylons rise pillars with smooth shafts, while at their foot, leaning against them, is a statue on a pedestal. At the pillars, situated in the Champs Elysées, the artists Lenoir and Michel have placed statues symbolizing France in the Middle Ages and in modern times. The statues at the end facing the Invalides, by Coutau and Margereste, represent France during the Renaissance and at the time of Louis XIV. Besides, there are four lions led by children, and, somewhat further on,

granite monoliths, ornamenting the approaches to this monument. On the platform, garlands of marine flowers and shells unite the pillars that support the highway upon the trusses. The balustrade is of bronze, and a pretty allegorical group, together with candelabras bearing 508 incandescent lamps, complete the decorative features of this remarkable bridge.

the edifices that line it, has a narrow appearance. Here have been installed all the industries connected with furnishing, and here are to be seen also a few reconstructed architectural monuments from the ancient provinces of France.

The two first buildings seen are those devoted to the national manufactures. Built with a hollowed-out front, their

FIG. 7.—VIEW LOOKING DOWN THE SEINE FROM THE PONT DE L'ALMA.

THE PALACES OF THE ESPLANADE DES INVALIDES.

Upon reaching the Esplanade des Invalides, after having traversed the Alexandre III. Bridge, we enjoy a magnificent panorama. The perspective formed by the Palaces on both sides and the dome of the old Hôtel des Invalides in the background of the central avenue produce an overpowering æsthetic impression. Notwithstanding its great width of 35 metres, this avenue, on account of the height of object is to accustom the eyes to the straight road in the middle. They comprise two symmetrical bodies of edifices whose sculptural decorations are identical. One of these façades opens upon the quay, the other upon beds of flowers. Their galleries are straight and terraces with walls in the background complete the structure. A circular portico flanked by two gables gives access to a monumental staircase which connects them with the adjoining buildings. These latter do not

resemble each other ; each has its own style, though their porches face each other and the open galleries are so arranged as to form counterparts, while their clock-towers are built on the same axis. The palaces on the right are occupied by the foreign sections containing exhibits of furniture and objects for decorating and equipping the interior of public and private buildings, while the buildings on the left are specially reserved to French industrial exhibits of analogous character.

The Palace in the background (Fig. 4), touching on the Place des Invalides, is built with the same object in view as those of the National Manufactures. It consists of two twin structures and a circular court, which is open at the ends of its axis, forming a continuation of the Central Avenue, whose clock-towers, surmounted by slender spires, are visible at the entrance. Two great friezes painted in terra-cotta colour decorate the façades in front of us. Behind the lines of these edifices, which are only 50 metres deep, the space left open near the Rue Fabert has been allotted to the annexes of certain foreign exhibition buildings, while on the corresponding place near the Rue Constantine have been reproduced a number of typical buildings of the ancient provinces of France : Lorraine, Provence, Poitou, and Brittany. The architecture of the latter, not to mention that of the other provinces, is original enough to deserve a share of our attention. We enter this portion of the Exhibition by a triumphal arch, copied from a cemetery near Landerneau, and arrive in front of a real gem of Renaissance style, the residence of the Duchess Anne ; a little further on we perceive the megalithic monuments, the marvellous calvary of Plongastel, and the house with wood panels from Morlaix, which, together with some fountains and granite pylons, gives to the whole a decisive local colouring.

LA "RUE DES NATIONS."

On the slope of the left bank of the Seine from the Pont de l'Alma to the Pont des Invalides a platform has been erected to serve as a solid flooring from which rise the Pavilions of the Foreign Powers (Fig. 5) in a line parallel with the river ; interesting structures, for they typify, so to say, the architecture of the various countries of the globe. First we perceive the pavilion of Italy, a vast building of rectangular shape, 65 by 28 metres in extent. Each of its façades represents some portions of the most noteworthy buildings in the country, among them the Palace of the Doges and the famous Basilica of Saint Mark in Venice. Its great rose-windows, its friezes of mosaic, its bays with trefoiled mullions, its bases of many-coloured marble, its gilded cupolas, all these give it the appearance of a Gothic cathedral. The Palace of Turkey, crushed by its neighbours, recalls a pleasure-house on the shores of the Bosphorus. The Building of the United States is more imposing with its total height of 51½ metres. The entrance on the ground floor consists of a kind of triumphal arch, ornamented with great Corinthian columns and crowned by a quadriga representing the Goddess of Liberty on the chariot of Progress. Between the columns rises the equestrian statue of Washington, and upon the summit of the cupola the American eagle unfolds its golden wings. In the interior, the central portion consists of a great hall surmounted by a cupola decorated with historical paintings, and measuring 20 metres in diameter. The Palace of Austria recalls somewhat the style of Louis XIV.; that of Bosnia, in blue and white, gives a bright tone contrasting with the sombre impression of the Tower of Komorn flanking it and containing the remarkable collection of historical exhibits from Hungary. Next we come to the comfortable "Mansion" of Great Britain (Fig. 6), the framework of which is entirely of iron. With its

corner turrets and the sculptured coping of its high bay-windows, it reproduces "Kingston House" at Bradford-on-Avon in Wiltshire. In the interior we find a collection of artistic objects temporarily removed from various museums, together with an interesting plan of London and suburbs in relief, measuring 9 metres in length. Four rooms of the building show us the appearance of the comfortably and tastefully furnished dwelling rooms of a rich family in modern England. The architects of the Pavilion of Belgium have endeavoured to show us a specimen of Flemish architecture, by copying the town-hall of Oudenarde, built in 1530. Who, upon looking at the fine stone carving, resembling lace, the niches with their statues, the open-work steeples and the belfry rising daringly upward, would imagine that all this has been constructed by means of the most modern process, the use of "ciment armé" (stiffened cement), covered with "staff."

Painted in red and green stands the Châlet of Norway before us, entirely built of wood. Its high roofs and façades are very picturesque. The building has been constructed in all its details by Messrs. Thams & Co., of Trondjheim, and has been put together piece by piece in Paris. Its overhanging balconies, its spire, 35 mètres in height, and the warm tone of the whole unwittingly arrest our attention.

The Pavilion of Germany, standing next to it, bears a more serious and austere aspect. It is a reproduction of a Renaissance building. The style of the decorations reminds us of the old houses of Nuremberg or Heidelberg. The roof with varnished tiles, the slender gables painted in many colours, ornamented with traceries of stone—all these are represented. Built and designed in the Moorish style of architecture, the Château of Spain is a square structure, from which springs forth at right angles a high and massive tower crowned with elegant crenulated battlements. One of the façades represents the University of Alcala, which dates from the sixteenth century. Near to it is the building of the Principality of Monaco. It represents an Oriental fortress of bizarre appearance, in which the naturalist who rules this miniature monarchy exhibits the icthyological specimens that he has collected during his voyages. Sweden has erected for herself a strange edifice all of wood, ornamented by open-work carving. It represents in its entirety a high central tower, flanked on its corners by four smaller towers of fantastic appearance. Servia and Greece are represented by modest Byzantine structures with tapering cupolas, and these are the last in the "Rue des Nations," that rise on the bank of the Seine. Behind them, also in a direction parallel with the river, the pavilions of the other Powers form a row facing the buildings above described. They are, however, less important, and deserve but a hasty glance. Roumania, following the example of Servia and Greece, has selected a building of Byzantine style; Finland is represented by a primitive châlet of wood; Portugal has chosen its style from the Far East; while Luxembourg has reproduced a portion of the Ducal Palace. The Pavilion of Persia, painted in white and pale blue, set off by mosaics, reflects a sky more luminous than ours. Denmark, finally, whose pavilion is merely a reading-room, has reproduced an ancient middle-class dwelling, in which wood and brick are attractively combined.

Following the Quai d'Orsay, after having left the "Rue des Nations" and traversed the Pont de l'Alma, we come to the Pavilion of Mexico, crowned by a frieze of tracery work hiding the glass roof. Somewhat further on rises the Palace of Hygiene, which is not worthy of description. Though its collections will no doubt be interesting to specialists and perhaps even to laymen, its architecture will not arrest anybody's attention.

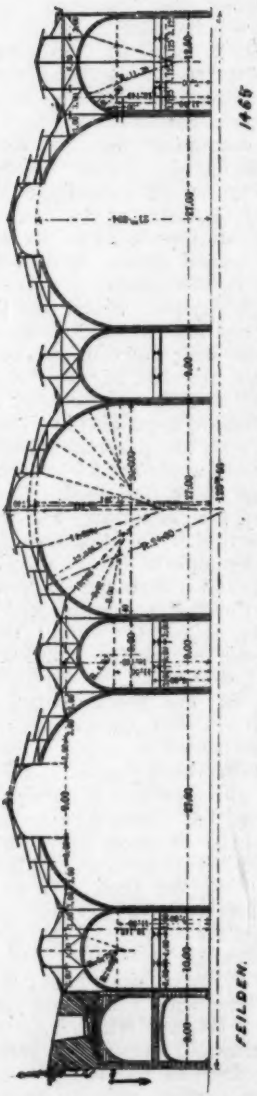


FIG. 8.—THE PALACE OF CIVIL ENGINEERING: SECTIONAL ELEVATION.

Some distance from it rises the "Palace of the Armies on Land and Sea" (Fig. 7), reminding us of a fortified place of the Middle Ages. Its façade on the river side imitates a dungeon flanked by two staircases, and its wings end in square towers crowned by parapets. Proceeding on our way, we may stop a moment before the Pavilion of Schneider, a dome, painted in red, having 43 metres in diameter and sheltering the products of the steel-works, foundries, and workshops of Creusot. Adjoining to it are less sumptuous buildings, which are without any special distinction, devoted to the Merchant Marine, the Messageries Maritimes, and the Chamber of Commerce of Paris. Beyond them, below the Pont de Jéna, rises the Palace of Forestry, Hunting and Fishing, the principal gate of which is surmounted by splendid bas-reliefs representing forest scenes, such as a contest between stags, for instance. Its chief façade runs parallel to, and faces, the Seine, extending over a length of 189 metres, and is tastefully ornamented with cynegetic decorations. A few steps further on, upon the Quai de Jarel, are to be seen the pumping works, containing the gigantic rotary pumps which furnish the cascade of the "Water Palace," with the 200,000 litres of water per hour which it requires.

THE PALACES OF THE CHAMP DE MARS.

The group of palaces on the Champ de Mars, considered as a whole, consists of a double row of edifices, lining an avenue perpendicular to the course of the Seine. From the point of view of a visitor who approaches them after having crossed the Pont de Jéna and passed below the Eiffel Tower, there rises to the left the Palace of Mines and Metallurgy; behind it the Palace of Thread, Tissues and Wearing Apparel, and beyond the latter the Palace of Mechanics. To the right appears the Palace of Literature, Science and Art,

then the Palace of Civil Engineering and beyond it the Palace of Chemical Industries. In the background the Water Castle and the Palace of Electricity close the picture, hiding from view the Great Machinery Hall, which has survived from the time of the Exhibition of 1889, though its interior equipment is new.

We shall not describe each of these monuments which would require useless reiterations, but shall confine ourselves to pointing out their characteristic features and their differences. Let it at once be said that all these edifices are symmetrical as regards the area covered, their height and the direction of their axes; they vary only with reference to the architectural idea embodied in each of them. Being connected with each other by means of corner pavilions, the edifices forming the centre of each line of front have a length of about 280 metres and a depth of about 130 metres. They represent two rows of façades, the one toward the Avenue de Suffren and the Avenue de la Bourdonnais, the other facing the gardens of the Champ de Mars. The latter façades are distinguished by a broader treatment. The cross sections of these buildings are practically the same in every case, consisting of three trussed girders of a length of 27 metres each, separated by galleries of 9 metres with a nave of 12·50 metres behind, and one of 10 metres in front. Besides, all along the principal façade is a border 8 metres wide (Fig. 8). There exists, therefore, an uninterrupted suite of halls, leading from one end to the other end of the Champ de Mars. Moreover, there is a platform 7 metres above the ground in various portions of these buildings, which adds to the available space for the display of exhibits.

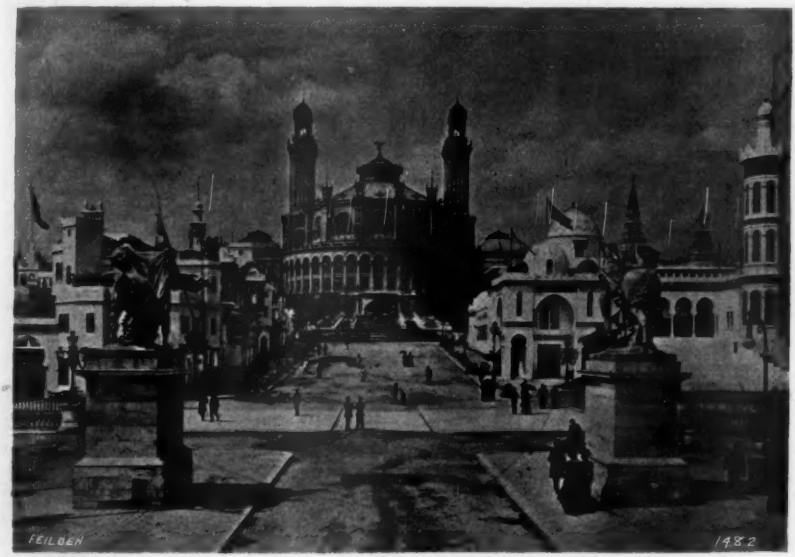


FIG. 9.—THE TROCADERO. THE ALGERIAN AND TUNISIAN SECTIONS ARE TO THE RIGHT AND LEFT.

The Palace of Mines and Metallurgy and its counterpart the Palace of Litera-

ture have a frontage of 95 metres facing the gardens, and another of 75 metres only, facing the river. The principal entrance, surmounted by a dome, which has the appearance of a gigantic tiara, is flanked by two circular pavilions. In the campanile is a chime of 32 bells which can play a variety of airs, the biggest bell weighing 840 kilogrammes, while the weight of the smallest does not exceed 4 kilogrammes. The portico opens upon a circular hall communicating with the great nave.

The chief façade of the Palace of Civil Engineering has in the middle an ornamental portico, flanked in its projecting portion by two rectangular towers crowned by belfries. Above the arcades a frieze 2·75 metres in width extends on either side. It is the work of the sculptor Allar, and is ornamented with representations of the means of transport used by man from the primitive carts of the Hebrews and Assyrians up to the modern automotor vehicles. The Palace of Thread, Tissues and Wearing Apparel is in the interior similarly arranged, but as the middle portion of the façade, which runs parellel with the Avenue de la Bourdonnais, coincides with the point where the latter is met by the Avenue Rapp, it was necessary to construct at this point a monumental entrance. This entrance is a portico with a rounded off vault decorated with paintings in brilliant colours. A frieze containing the words: *Fils, Tissus, Vêtements* runs around it, while a reclining statue representing Fashion, resting on the inner portion of a scroll, symbolizes the leading idea. Like the building facing, it is flanked by pylons with campaniles. The remainder of the façade is a succession of semi-circular arcades surmounted by an iron balcony. A double staircase in the interior leads up to the corner pavilion, connecting this balcony with the adjoining one.

The Palace of Electricity, which with its height of 70 metres dominates the neighbouring structures, forms, so to say, the background of this marvellous perspective. It is constructed entirely of glass and iron, and has a length of 130 metres. The Water Castle and two semi-circular rows of terraces are in front of it. The general form of its roof represents an immense arch of trefoil work produced by numerous little arches side by side and on top of each other, supported by pylons diminishing upward in size. The crest consists of open-work zinc looking like lace, and in the centre is a scroll bearing the date 1900, surmounted by the fairy of electricity standing upright on a chariot and wielding the torch of Progress. Nine bay recesses with coloured glass windows form the façade, from which in the daytime the sunlight is reflected, while at night 5,000 incandescent lamps and 12 arc lamps with reflectors produce an admirable illumination. The Water Castle consists of an immense hemispherical grotto, having a width of 30 metres and a depth of 11 metres, furnished with a series of receptacles, amphitheatrically arranged, from which flow cascades, emptying their water into a great central basin.

The Great Machinery Hall has been entirely remodelled in the interior. It has been divided into three sections of almost equal size. The two outer sections have been allotted to exhibits of food stuffs and agricultural products, both of French and foreign origin. High porticos, ornamented with field flowers, leaves and fruits constitute its decorations. The centre of the edifice is occupied by the great Hall for Festivals, the area of which exceeds 6,000 square metres, and 25,000 persons can comfortably move about in it. It is a kind of immense circus decorated and lighted by 4,500 incandescent lamps.

The above may suffice to give a general idea of the arrangement of the edifices on the Champ de Mars. French gardens surround them, while the Eiffel Tower is framed by English gardens of less severe aspect. Near its base are installed numerous shows of various

description. To mention a few of them there is "Venice in Paris," for instance, and the "Mareorama," where the visitor can enjoy the illusion of a trip on the Mediterranean, obtaining a glimpse of Marseilles, Tunis, Naples and Constantinople. Then there is Poucin's Luminous Palace, entirely built of glass, including columns, statues, roof and flooring. Leaving on the way the Alpine Club, Siam,

Let us say a few words now about the famous moving side-walk (Fig. 10), designed by the engineer de Montcomble, by which the visitors are transported from the Esplanade des Invalides to the Champ de Mars. Its track, which passes along the Quai d'Orsay, the Avenue de la Bourdonnais, the Avenue de la Motte Picquet, and the Rue Fabert, has a length of 3,370 metres. This moving side-walk consists of two

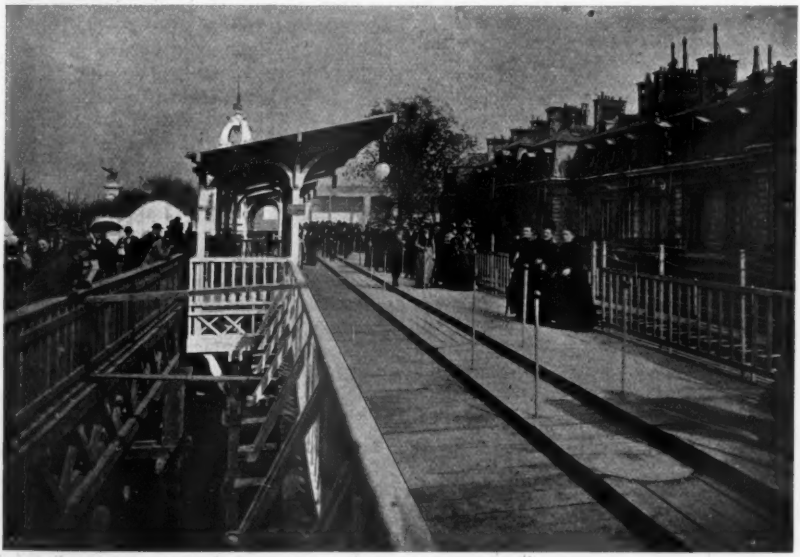


FIG. 10.—THE MOVING SIDE WALK: STATION DES INVALIDES.

and Guatemala, we may stay a moment at the Optical Palace, which alone occupies a space of 8,500 square metres. Its entrance is situated opposite the western foot of the Eiffel Tower, and surmounted by a great demi-cupola on the face of which are represented the twelve signs of the zodiac. In this building an immense siderostat may be seen with lenses of 1·25 metres diameter and a focus of 50 metres, through which the stars appear magnified 10,000 times.

rolling platforms. One of them, 2 metres wide, moves at the rate of 8·5 kilometres per hour, the other, only 0·85 metres in width, has a velocity of 4·25 kilometres per hour; and parallel with the latter is a fixed side-walk 1 metre wide. The moving portion consists of a series of trucks with platforms rounded off at their extremities so as to fit into each other. They rest by means of cross-beams upon rollers kept in motion by dynamos supplied with a continuous current of 500 volts. The

rollers for the fast-moving platform have a diameter of 0·70 metre, those for the slower side-walk have a diameter of 0·35 metre only. The whole side-walk rests on a metallic viaduct supported by wooden pillars in order to deaden the vibration. There are nine stations along the line at the height of the first stories of the Palaces of the Exposition. Our photograph shows the station at the Invalides.

THE TROCADERO AND THE RIGHT BANK OF THE SEINE FROM THE PONT DE JENA TO THE PONT DES INVALIDES.

The first exhibit near the Trocadero, on both sides of the Central Avenue, which forms a prolongation of the Pont de Jéna, is that of the Algerian section. Toward the right is a pleasing Arabian structure dominated by a reproduction of the Minaret of Sidi-Bou-Médine near Tlemcen. The interior, after the style of oriental dwellings, consists, as is the case in these, of courts surrounded by colonnades and porticos. In the middle of the central hall is a white marble basin in which plays a fountain, while near by the "muezzin" sings the "ezzan," summoning the faithful to prayer, all of which adds to our illusion of being a witness to the peaceful life of the Mohammedans. Opposite we perceive an Algerian village in miniature, which in its entire length is traversed by a tortuous street, copied from that of the Kasbah. There we find Moorish cafés and tiny shops in which the natives pursue their picturesque trades. At the end of this exhibit rises a stereorama in which are represented the most picturesque sites from Oran to Bôue.

More to the left is the Tunisian exhibit, the principal entrance to which faces the river. It covers an area of 4,000 square metres. Thirty-four stalls constitute this "souk," which does not lack local colour, for many active artisans pursue their trade there, among them a brazier from Kaironan, a jeweller from Mokenine, and a weaver of blankets from Jafsa. Besides, various special features, such as the mosques of Sidi-Maklouf at Kef and of Sidi Mahrez at Tunis, together with a café of Susa, complete this graceful complex where the Protectorate introduces us to her agricultural, industrial and commercial progress.

Continuing our promenade toward the left along the Quai de Billy, we come upon the pavilions of Senegal, of the Sudan, of Dahomey, of the Ivory Coast and of the French Indies, primitive indigenous structures of which not much can be said. We give preference rather to the Indo-Chinese edifices, *i.e.*, to those from Cambodia, Cochin-China, Annan and Tonkin. The first of these crowns an artificial hill, containing in its interior an immense subterranean hall where dioramas recall to our mind the memories of the past of this mysterious land. By a staircase we mount to the upper terrace, which is surmounted by a pagoda, partially constructed at Pnom-Penh, at the order of King Norodom. The building, in which are exhibited the various products of the colony, represents the house of a wealthy native of Thudaumot (Upper Cochin-China), decorated with pretty carved panels. Finally, to the left there is a Cambodian village, with its huts perched upon strong bamboo poles, surrounding ruins in a state of sufficient preservation to give us an idea of Khmer art.

The less important pavilions, such as those of Guadaloupe, of the Ministry for the Colonies, and of New Caledonia, are grouped together near the arched entrance to the Trocadero, the last vestige of the International Exhibition of 1878. Let us pass over a few annexes, such as those of Andalusia during the time of the Moors, of the Congo, of Madagascar and of the French collieries, and pay a visit to the foreign colonies.

One of the most remarkable exhibits is that of Russia in Asia, which alone occupies an area of 6,000 square metres.

Its buildings represent a partial reconstruction of the Kremlin of Moscow, and the proportions are obviously the same as those of the original, one of the clock towers reaching the height of 50 metres. The crenulated battlements of the surrounding walls and the whole appearance remind us of the architectural types of the Oriental-Byzantine epoch. Behind the façades extends a great court, surrounded by "Samovars," or, may be, swallows' nests, for the terminus is a station in China whence we enter into the Palace of the Celestial Empire. The principal pavilion of this latter recalls to our mind one of the gates in the wall surrounding Pekin, with its many-storied tower. The other building, of more modest appearance, is ornamented with a frieze of carved wood, with light brackets at the protruding

FIG. 11.—THE CONSERVATORIES. VIEW FROM THE LEFT BANK OF THE RIVER.

the buildings in which are piled up the industrial products. Joined to this is an originally conceived exhibit of the Sleeping Car Company of the Trans-Siberian Railway. The visitor comfortably resting in the car sees through the windows on either side passing before his eyes the scenery through which this railway travels from Moscow to Pekin. In order to complete the illusion, there are stoppages at the different stations where are served, according to the character of the country, portions of the lower roof and slender columns supporting the verandah. Alongside of the Rue de Magdebourg we come upon the less interesting buildings of the Portuguese colonies and the Pavilion of the Transvaal, in front of which there is always a great crowd of visitors. Near to it is a Boer farm, a low, square building covered with a straw roof, giving the impression of rustic simplicity. Behind it, bordering on the central basin of the Trocadero, within the section of

the Dutch Indies, we perceive an imitation of the curious temple of Tandji-Sari at Java. Two smaller sanctuaries are reconstructed after the ruins of Prambanam and of Boro-Boudor, those marvellous examples of Brahmin art. The base is covered by bas-reliefs representing the life of Buddha. Two lateral pavilions situated on the same terrace represent types of native dwellings from Padang, in the island of Sumatra. The façades of carved wood are also moulded from originals in the Malay archipelago.

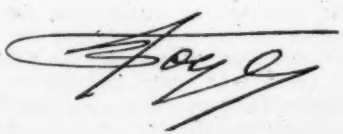
On the other side of the avenue, parallel with the Seine, we behold the edifices of the British section. The Palace of India is a magnificent structure in beautiful Hindu style, covering a space of 200 square metres. Its imposing façade consists of a great portal, between two circular towers. On either side run galleries with slender columns ; and decorations moulded from sculptures of the country form its graceful ornaments. In the interior one's attention is attracted by the balustrades of the great staircase, constructed of carved wood by artists from Burmah. Behind this edifice rises the Palace of the Colonies of the United Kingdom, a rather odd structure from an architectural point of view, but containing the very noteworthy exhibits of Canada and Australia. At the corner of the Avenue de Iéna, stands the massive pavilion of Egypt, and close to it is the Japanese section, the chief building of which, serving for the exhibition of ancient works of art, is a copy of the pagoda of Kondo, a Buddhist monastery constructed in the 8th century near Nora.

After leaving the Trocadero let us follow the Quai de Billy, where we will pass over the hideous restaurant building and that of the Chamber of Maritime Commerce, whose exterior is nothing less than æsthetic. The lighthouse, erected on the banks of the Seine by the Biscuit Factory Lefevre of Nantes, alone introduces a more pleasing detail into the confusing mixture of façades seen in the distance, behind the foot-bridge, in our photograph. (Fig. 7).

We now come to "Old Paris," the work of the artist Robida, a row of high houses, 300 metres in length, erected on the bank of the river and recalling to our memory the most curious architectural specimens of the Middle Ages and the Renaissance. The taverns and shops, with the tradesmen in the garb of the period, attract every day larger crowds of visitors.

We will now pass through the magnificent conservatories (Fig. 11) which contain all that belongs to the domain of agriculture. Each of them is 83 metres long, 32 metres wide, and 21 metres high. They comprise a central nave flanked by lower side galleries, alongside of which run "loggias," and will remain standing after the closing of the Exhibition, to serve for horticultural shows. Somewhat to the right in our photograph we perceive the Pavilion of the City of Paris. Its profile, rather sombre in general aspect, stands gracefully out against the sky, with its pointed gables and slender turrets. It contains chiefly collections of plans and engravings, enabling the visitor to follow the progress of public works executed by the municipality within the course of the last ten years.

Before concluding these lines, let us form a wish : May this International Festival mark a new stage in the progress of civilisation, may human genius henceforth continue, without hindrance, its march toward the ideal of our dreams, the Brotherhood of all Nations.



Pneumatic Tools and Appliances.

By EWART C. AMOS, M.I.Mech.E.

(Continued from page 647.)

❀ ❀ ❀

For tube expanding a reversible pneumatic drill effects immense saving over the ordinary method hitherto adopted ; even after taking into consideration the cost of producing the compressed air, and apart from being able to turn out the work so much quicker, the advantages of its use are many. The question of comparative cost will be dealt with in the next and concluding article of this series on pneumatic tools, but it may be stated here that such a machine as illustrated in Fig. 89 is able to roll steel boiler tubes $1\frac{7}{8}$in. diameter in 30 seconds as against 10 minutes by hand rolling, and with a result in every way as satisfactory. This test was recently made at the Great Western Railway Works, and there is every reason to believe that few boiler shops will in the future be able to do without such a machine. For tube expanding a pneumatic drill is an ideal machine.

Yet another application of the pneumatic drill is for removing old boiler tubes or for cutting off the surplus ends of new tubes. Fig. 90 shews an outside view of a machine for this purpose, whilst Figs. 91 and 92 show sections of the working parts of the attachment. Any form of pneumatic motor may be used, the one illustrated being of the Hæsler type and, together with the attachment, belonging to the Chicago Pneumatic Tool Co. Referring to Fig. 91 and the letters of reference shewn on same, *a* is the tube of any boiler from which it is desired to remove one or more tubes ; *b* is the tube under removal, whilst *c* is a roller cutter carried in a shank *d* and revolved by the pneumatic motor *e*. The cutter *c* is carried in a block *f* which is backed up by a feeding wedge *g*. It will also be noticed that attached to the driving spindle of the machine is a small air cylinder *h*, having a piston *i* which is directly connected to the wedge *g*, already referred to. There is also a spring placed inside the cylinder *h* for the purpose of withdrawing the roller cutter. The action is as follows :—Air is admitted simultaneously to the motor and to the cylinder *h*. This causes the

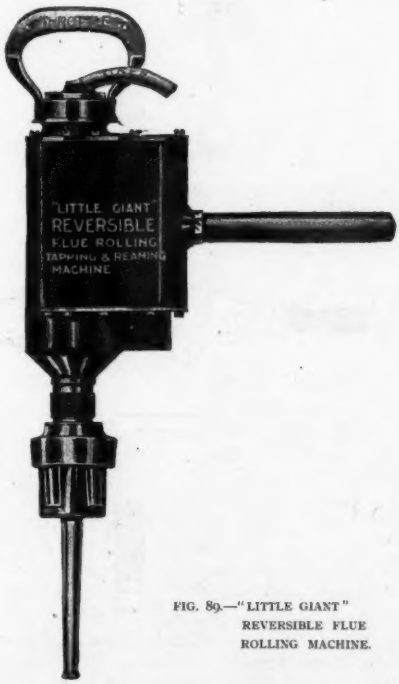


FIG. 89.—"LITTLE GIANT" REVERSIBLE FLUE ROLLING MACHINE.

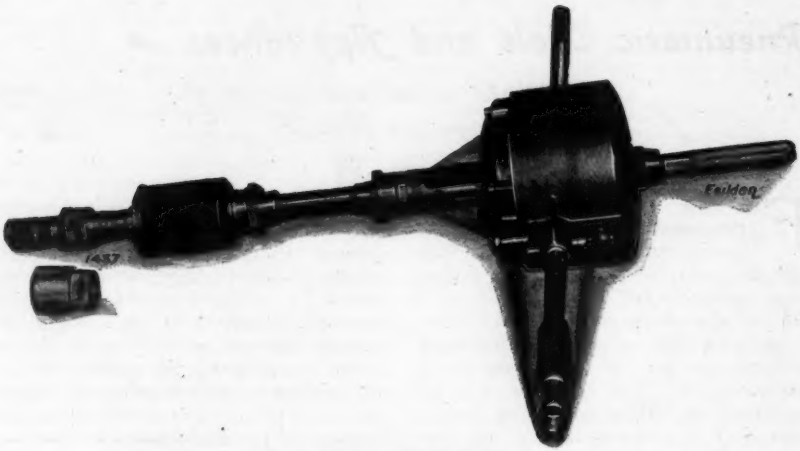


FIG. 90.—PNEUMATIC BOILER TUBE CUTTER.

FIG. 91.

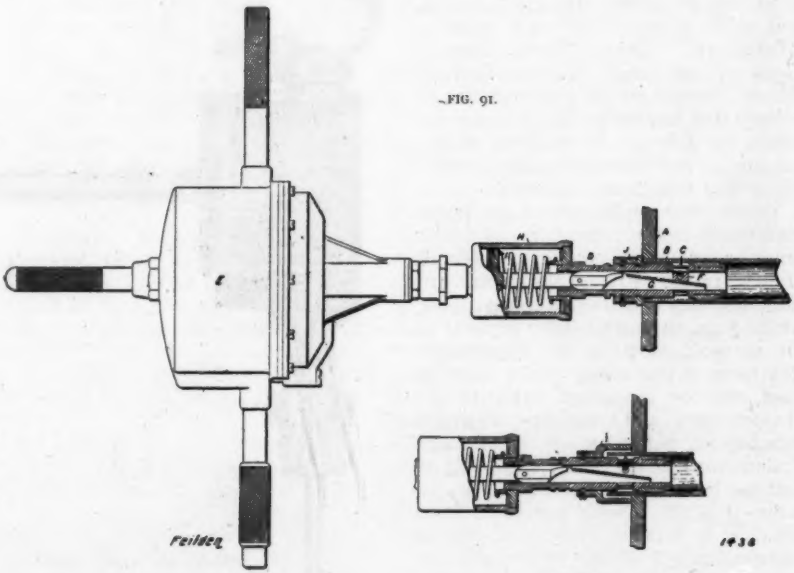


FIG. 92.

FIGS. 91 AND 92.—SECTIONAL ELEVATIONS OF TUBE CUTTER.

cutter to be revolved within the flue and at the same time the piston *i*, acting on the wedge *g*, forces the cutter radially outwards against the tube, which is thus rapidly cut through. On the air being shut off, the spring within the feed cylinder *h* withdraws the wedge and the cutter and the tool are removed from the tube. A stop gauge *j* provides for cutting the tubes all to the same length.

Fig. 92 shews a slight modification of the apparatus when it is used for cutting off the surplus ends of new tubes to a uniform length after they have been put in the boiler and expanded at the opposite end. The only difference is in the stop gauge, which it will be seen is enlarged in diameter and length, so as to enclose the projecting end of the tube and also bears against the tube plate. Several notches will be seen in the hollow shank outside the stop gauge ; these allow of stop gauges of various lengths to be used in order to cut the tubes at different points as desired. It will readily be understood that by lengthening the drill shank the motor can be brought outside the smokebox, so as to allow of cutting the extreme outer tubes. It is generally convenient to mount this motor on a balanced rope gear which secures easy handling.

Such a device as here described and illustrated will be found very convenient for cutting out and cutting off tubes of all kinds.

Did space permit, many more such applications of the pneumatic drill and other tools might be shewn, and they are almost daily becoming more numerous.

Not the least useful of pneumatic appliances are air hoists, and in fact they have been used by engineers for many years, even before drills and hammers were adopted. Their application, however, is now being very largely extended, owing to the rapid introduction of pneumatic tools and a consequent necessity for a source of

FIG. 93.—"SENTINEL" PNEUMATIC HOIST.

air supply. Previous to this, the air hoists did not appeal so strongly to manufacturers on account of having to put down a compressing plant for that alone. A trial of an air hoist always ensures its continual use, as the economy effected when suspended over a lathe or other machine tool, is very considerable, besides enabling the machinist to handle his own work without the assistance of a labourer. It also means that he can handle that work at once, without, as is frequently the case, having to wait for a labourer. In fact the pneumatic hoist may be looked upon as a great labour saver in many ways, and for a large range of work it is more economical than a chain block, since its action if far more rapid both in raising and lowering. Moreover, it is exceedingly sensitive, and enables work to be rapidly brought into

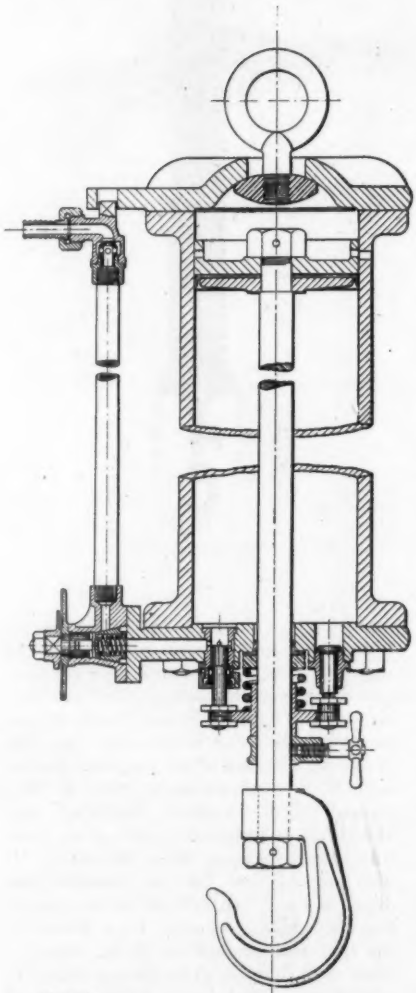


FIG. 94.—VERTICAL SECTION OF "SENTINEL" HOIST.

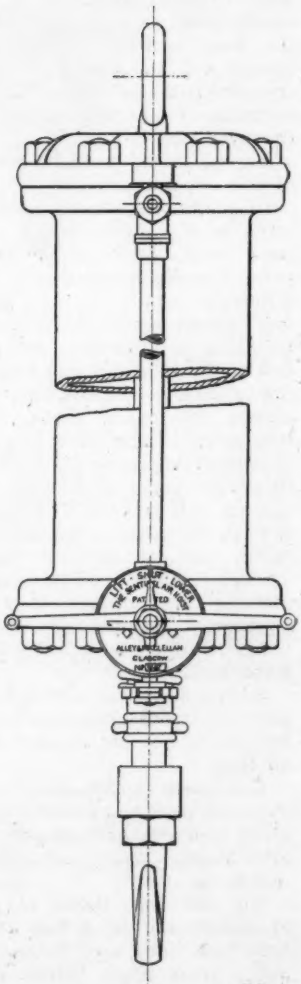
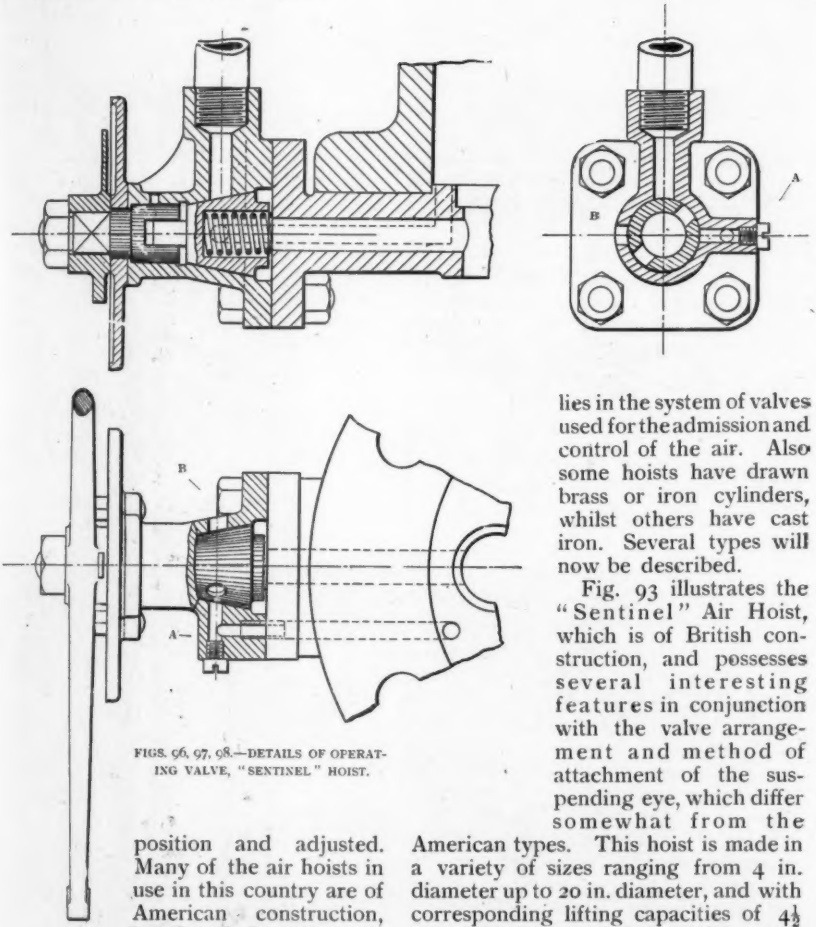


FIG. 95.—ELEVATION OF "SENTINEL" HOIST.



FIGS. 96, 97, 98.—DETAILS OF OPERATING VALVE, "SENTINEL" HOIST.

position and adjusted. Many of the air hoists in use in this country are of American construction, but British firms are now well to the fore, and are introducing some novel features. The principle upon which they all work, however, is largely the same, viz., a long cylinder with a sliding piston and rod. The piston rod passes through a stuffing box at the lower end, and has fitted to it a hook or loop. Live air admitted to the underside of the piston raises the load, and the exhaust of same causes the load to lower. The difference between the various types of hoists lies in the system of valves used for the admission and control of the air. Also some hoists have drawn brass or iron cylinders, whilst others have cast iron. Several types will now be described.

Fig. 93 illustrates the "Sentinel" Air Hoist, which is of British construction, and possesses several interesting features in conjunction with the valve arrangement and method of attachment of the suspending eye, which differ somewhat from the American types. This hoist is made in a variety of sizes ranging from 4 in. diameter up to 20 in. diameter, and with corresponding lifting capacities of $4\frac{1}{2}$ cwts. up to 9 tons when working with an air pressure of about 70 lbs. Fig. 94 shows a complete vertical section; Fig. 95 shows an outside view protracted from the same drawing; whilst Figs. 96, 97 and 98 show details of the controlling valve. The makers of this hoist adopt cast-iron cylinders for all sizes with leather packing for the pistons and stuffing boxes. In respect to this point it may be mentioned that some English makers use "woodite" for the piston packing in preference to leather, as it is stated

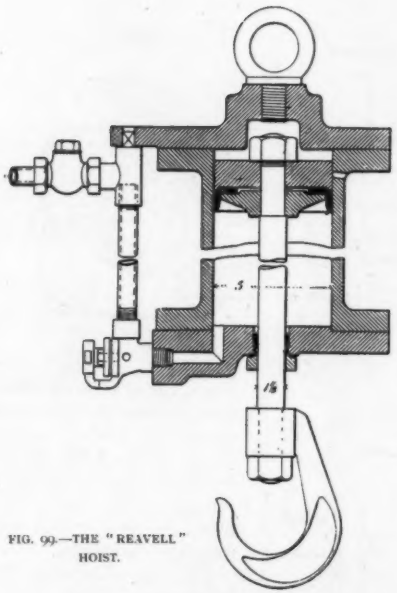


FIG. 99.—THE "REAVELL" HOIST.

that it has less tendency to harden, and is, consequently, less liable to permit leakage. This method is carried out in the "Reavell" type of hoist, which will next be described. It will be noticed in the "Sentinel" air hoist that the suspending eye has a spherical bearing, which enables the hoist to be swung off at any angle, and since the compressed air is only acting upon the underside of the piston, there is no fear of leakage in this direction. The weight of the hoist is found to be enough to make a sufficiently good joint at this point in order to secure a cushion of air to prevent overrunning, which will be described later on. The air supply is connected to the top of the pipe seen on the left of the cylinder (Fig. 94), and immediately below this connection will be seen a small non-return valve which immediately shuts should the hose break, or the air pressure be reduced. This retains the full air pressure in the hoist and prevents the

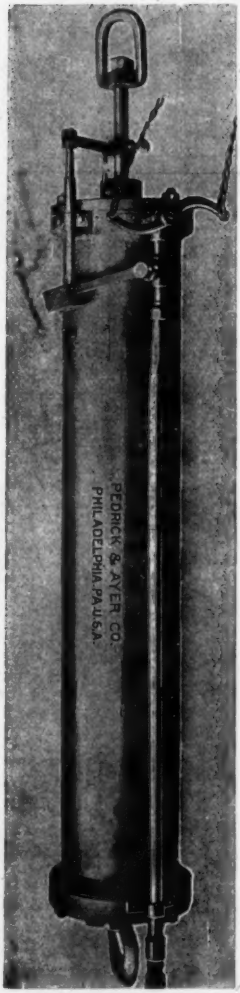


FIG. 100.—THE PEDRICK AND AYER PNEUMATIC HOIST.

load dropping. Before entering the cylinder the air has to pass another valve placed at the bottom of the small pipe already referred to; this is the operating valve, which is seen more clearly in the detail views Figs. 96, 97 and 98. This valve is provided with an index plate, and is worked by a lever having a hand chain at either end which is worked by the operator for lifting and lowering the load. In order to prevent side strain on the valve due to the pull on the lever, the taper plug is separate from the spindle to which the lever is attached, and has a projection fitting over a corresponding cross channel on the spindle. This ensures perfect freedom of the valve, which always remains tight. In the bottom cylinder cover are fitted two valves which form a combined air-saving and balancing device. Their object is to secure a continued suspension of the load, and further, the supply of just sufficient air pressure for a given load, so that when a light load is raised additional air will not be wasted by the subsequent filling of the cylinder with air at full pressure, as is frequently done with some of the common types of hoists. The operating valve having been opened, the height of the lift can be regulated by adjusting the collar shown on the piston rod outside the stuffing box, since, as soon as this collar comes into contact with a sliding sleeve (which is held down by a helical spring) it brings into action the two valves shown in the bottom cover. The sliding sleeve referred to has two arms, one of which operates a piston valve on the left and the other a poppet valve on the right. When the piston rises, it shuts off the air supply, and the hoisting stops. If the load becomes lighter, as occurs for instance, when pouring molten iron from a suspended

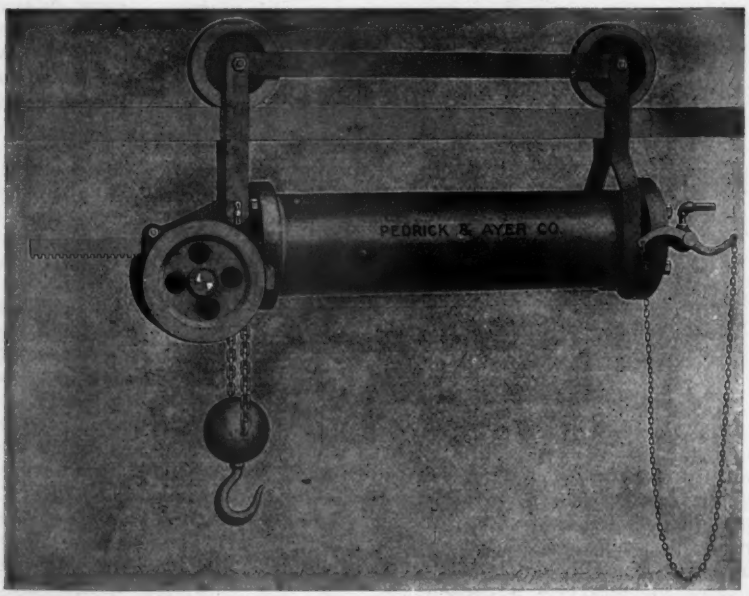


FIG. 101.—PEDRICK AND AYER HORIZONTAL PNEUMATIC DIFFERENTIAL HOIST.

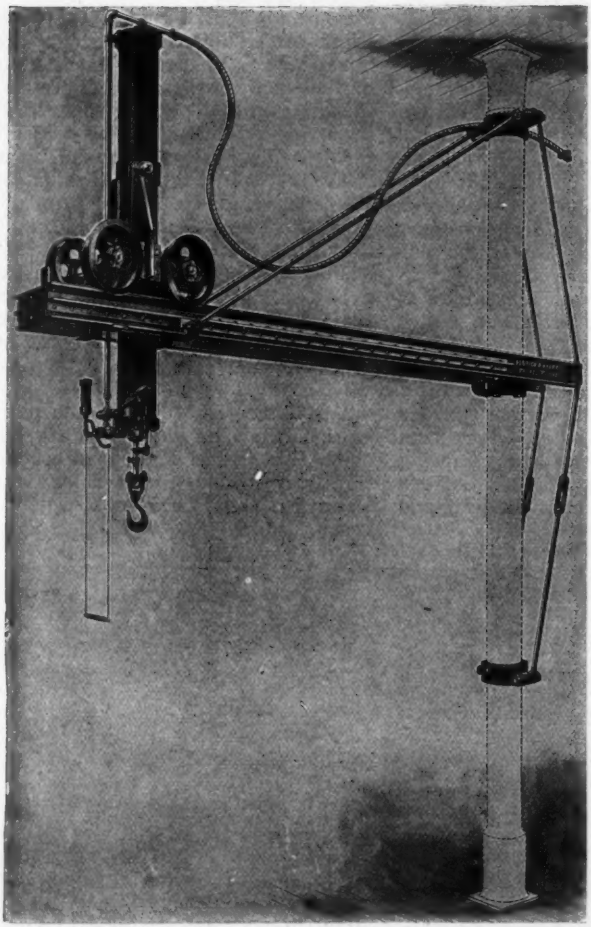


FIG. 102.—PNEUMATIC HOIST POST JIB CRANE.

ladle, the piston rises a little higher, and this causes the poppet valve to open and a little air to be discharged from the cylinder, leaving the pressure within just sufficient to balance the reduced load. When it is required to balance the load for a considerable time, a slight leakage frequently occurs. Should this take place, the effect of the piston descending opens the piston valve, and admits a little more air to compensate for such loss. When the piston valve is up, it, of course, closes the exhaust from the main inlet. On reversing the handle of the operating valve to lower the load the release first takes place through the bye-pass *a* (see Figs. 97 and 98) until the piston descends a little, and after that the air can escape through the main outlet *b*. As is usual in most pneumatic hoists an air cushion is formed on the upper end of the cylinder by drilling a small hole near the top. This hole being closed by the piston as it nears the end of its upward stroke, and compressing the enclosed air, forms a cushion, and brings the piston gradually to rest. In this hoist this only occurs when the automatic stop is not in use.

Fig. 99 shews a section of another British type of hoist, viz., the "Reavell" hoist. This is made in various sizes, the one illustrated having a 5 in. diameter cylinder, and being capable of lifting ten to eleven cwts. with air

pressure at 75 lbs. per square in. The length of the cylinder is 4 ft. 6 ins. In this hoist there are two valves, the upper one being an ordinary non-return valve to prevent accidents in case of bursting of the air supply pipe, and the lower one being a plug valve, working by a lever and chain for lifting and lowering. A small hole near the top of the cylinder provides for the air cushion already referred to. The piston is packed with "woodite."

Fig. 100 shews an American hoist of the "Pedrick and Ayer" type. They are made in a variety of styles for different classes of work. For quick work, and where it is not necessary to keep the load suspended for any length of time, the hoist is fitted with one valve only. This valve is either an ordinary plug valve opened and closed by the operator by hand chain, or it may be an automatic self-closing valve to close when the hand chain is released. Another type is fitted with two valves, one valve for admitting and releasing the air, and left open to the supply when lifting the load, whilst the second valve is controlled by a loose collar and set screw in the piston rod. This second valve cuts off the air supply at any given point and at the same time in case of leakage, it automatically admits just enough air to keep up the supply and to retain load in position. Yet another type has three valves, and this type is shown in Fig. 100. The first two valves are the same as the two types just described. The third valve is a releasing valve to maintain a varying load in position, and this arrangement, it will be noted, embodies the conditions obtained in the "Sentinel" air hoist before referred to, only in a different way.

It may be interesting to refer here to the capacities and air consumption of a few sizes of straight lift hoists, such as those already described.

The following table may be taken to represent a fair average where the lift in all cases is taken as 4 ft. and the air pressure as 80 lb. per square inch :—

Size of hoist. Diameter of cylinder in ins.	Lifting capacity. Tons cwts.	Diameter of air supply pipe. Inch.	Amount of free air consumed per full stroke left of hoist. Cubic ft. free air.
4	8	½	2¼
6	17	½	5
8	1 10	¾	9
10	2 10	1	13½
12	3 10	1	19¾

Where headroom is limited a horizontal type of hoist may be used, but this arrangement is only suitable when accurate lifting is not required. It consists of a cylinder, piston, and piston rod, no stuffing box being used. The piston rod is of steel with a rack cut in the underside, which engages with a pinion on a forged shaft, and carrying the winding drums on which the chains revolve. The hoist is suspended by a fixture at each end ; the fixture over the chain drums sustaining the load, and the other being for the purpose of retaining the hoist in its proper position. Such a hoist, having a 6 in. diameter cylinder and a lift of 5 ft., will lift nearly ½ a ton, and is illustrated by Fig. 101.

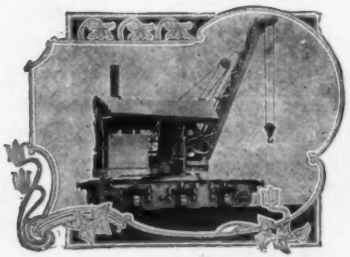
It will be readily understood that in combination with suitable framing, pneumatic hoists lend themselves very conveniently for forming cranes. They have proved themselves very useful both in foundry and general shop use, and are now receiving a very extended application.

Fig. 102 illustrates one form of a pneumatic hoist post jib crane, having a 16 ft. jib upon which is mounted a hoist capable of lifting 3 tons with a stroke of 6 ft. with 80 lbs. pressure. It is shewn with the jib attached to an existing column, which is shewn in dotted lines. The jib is built of channel and T irons, and is arranged to slew

right round the column. The top and botton clamps around the column are fitted with roller bearings. The hoist is mounted on a trolley, the wheels of which are also fitted with roller bearings, so that all the motions are easy, and permit of the hoist and load to be moved or revolved with very little expenditure of effort.

In the next and concluding article of this series on Pneumatic Tools and Appliances some miscellaneous tools will be illustrated and described, together with figures relating to the cost of the system.

(To be concluded.)



MACHINERY APPLIANCES AND PROCESSES.

"Every part and side of our life, from the cradle to the grave, has been touched and tended by the inventor and manufacturer. His works are as numberless as the sands of the sea, but the onward rush of Science and the Arts opens up new fields of discovery and enterprise as each day dawns. Let us choose here and there among thousands, and in choosing take the best as far as in us lies."

THE 1,500 K.W. AND 650 K.W. ALTERNATORS AT DEPTFORD.

At the present time it is quite usual to hear of a new electric lighting station being formed and plant laid down for distributing current at any pressure up to 10,000 volts, but ten years ago the same could not have been said ; indeed it was no further back than the year 1889 that the electrical world was startled by the announcement by Mr. Ferranti, who was then Consulting Engineer for the London Electric Supply Corporation, that an alternating current could be carried from Deptford along concentric cables for a distance of about eight miles, not only economically, but, what was obviously of more consequence, with absolute safety.

This immunity of danger was arrived at by earthing the outer on the cable, which, being in direct connection with one of the terminals on the alternator, consequently meant that the alternator had only one terminal or collector ring at a potential above that of "earth."

In speaking of the Deptford undertaking, it would be an interesting digression to relate a few of the many and enormous difficulties that confronted Mr. Ferranti, and of still greater interest to recount how all these were surmounted, and the original methods adopted in surmounting them. This subject, however interesting it may be, is not the purpose of the present article. What we hope to be able to offer to the reading public is a short and technical explanation, with illustrations of the two last additions to the nine single phase alternators now in commission at the London Electric Supply Corporation's Deptford Station.

As already mentioned, there are installed nine alternators of the following capacity :—Two 300 k.w., two 625, one 650 k.w., one 1,000 k.w., two 1,250 k.w., one 1,500 k.w., representing a total output of 7,500 kilowatts.

A description of the 1,500 k.w. and 650 k.w. alternators will be representative of the whole, as showing the general excellence in design, construction and attention that is paid in these machines to the high insulation of parts that otherwise might form a source of danger to the station attendants.

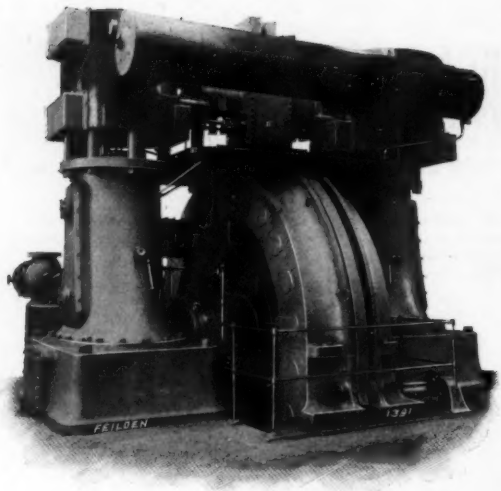
The 1,500 k.w. alternator is designed to give 150 amps. at 10,000 volts, periodicity 83 per second, 156 revs per minute, but has developed a current at 12,500 volts. The actual test load was 300 amps. and a difference of potential of 15,000 volts between the armature and earth.

The wheel on which the armature is mounted, and which, together with the latter, act as the fly-wheel of the engine, represent a considerable figure as stored energy when running at 156 revs. and insures steady running in parallel.

The casting is of iron in halves which are securely held together at the rim by steel rings shrunk on to the bosses at the sides. Besides the eight ordinary H section cast iron arms, there are eight steel tie-bolts, 6 in. diameter, which pass through the rim and are screwed into a steel block which is situated inside the cast iron wheel boss and shrunk on the shaft.

The wheel as a whole is secured to the shaft by steel rings shrunk on the cast iron boss.

The shaft on which the wheel is mounted is 20 in. diameter in the swell, and 12 in.

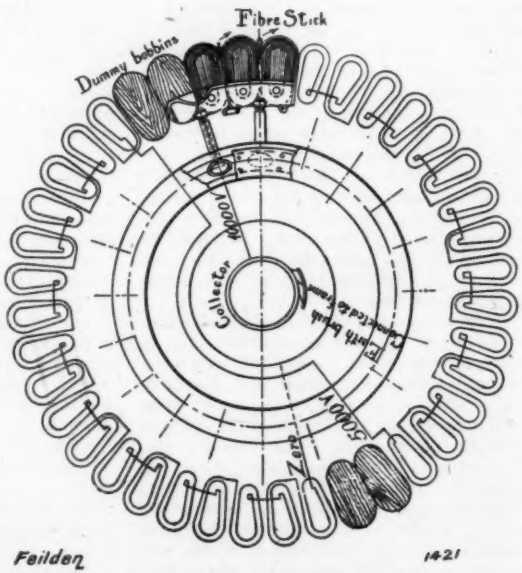


THE 1500 K.W. ALTERNATOR AT DEPTFORD.

diameter in the journals, which are 36 in. long, and which are lubricated by oil supplied under pressure of 15 to 20 lbs. from special pumps driven by small eccentrics attached to the outer end of the shaft. The oil is, of course, allowed to drain back by gravitation to a tank which is situated near the pumps.

The armature, consisting of 64 coils, is wound on cores which are built up in alternate layers of strips of brass and asbestos, and is of the usual form of Ferranti Patent Corrugated copper strip, which insures the winding being kept securely in position, and in an even plane around the circumference of the armature. The insulation between the turns consists of vulcanised fibre.

Each pair of coils is firmly held between, but insulated from machined gun-metal carriers which are rivetted together and form a very rigid unit. Passing through bosses on these carriers are steel bolts carrying phosphor bronze nuts, and the bolts, after passing through the outside of the wheel rim, screw into cast steel blocks, which are themselves embedded in a special sulphur compound run into cored pockets in the rim of the wheel. By the adjustment of the phosphor bronze nuts, it is readily seen that the armature can be trued up into line and made to form a rigid and mechanically sound ring of copper winding. It is, of course, essential that great care should be taken to insulate to a high degree the bolts that pass through the rim of the wheel, and, to effect this, the bolts, as well as the blocks in the cored pockets, are covered with ebonite and mica respectively before being bedded in the sulphur compound, thus giving an extra



FERRANTI ARMATURE, DIAGRAM OF WINDING.

precaution against failure in the shape of a "short to earth."

The current, after passing down specially insulated connections, is collected off a gun-metal ring, carried by, but insulated from the wheel boss, three copper gauze brushes, which are held in position by a gun-metal arm, the shank of which is highly insulated by ebonite, and is carried in a special bracket which in this instance takes the form of a box of cast iron. A short length of cable suffices to connect the above point to the switchboard.

In order to further prevent any possibility of accidents from attendants coming into contact with any live part, the whole of the collector gear is encased in a neat cast iron frame with glazed front and sides, but at the same time easy of access for purposes of cleaning.

On each side of the armature, allowing of an air-gap of about $\frac{3}{8}$ in., are ranged the 64 field magnets, which are forced into bored holes in the cast iron yoke, which itself forms part of the massive frames.

The field is excited by current passed round one layer on each pole of copper strip, which is wound on edge, and completely insulated from the steel core. By this method, which is of simple construction, the greatest possible radiating surface is exposed, and insulation between adjacent turns can be easily and effectively carried out. Any risk of the current in the armature flashing over to the pole faces is obviated by micanite caps being passed over the faces and firmly attached to the same. These caps, although of no greater thickness than $\frac{1}{16}$ in., safely withstand a test pressure of 20,000 volts.

In order to facilitate easy adjustment of the air-gap and reduce the friction in opening the two halves for purposes of cleaning and inspections, the feet of the frames are mounted on rollers, and the process of opening is effected by right and left hand screws connected together by an endless chain.

For barring round a special motor is provided, being connected through geared wheels, and worm on to a worm wheel bolted to the face of the flywheel boss.

The pitch circle of the field magnets is 20 ft., and a fact that more than anything else points to the mechanically sound construction of the armature is that the tips of the armature coils attain the high lineal velocity of 10,600 ft. per minute. For the protection of the station attendants from the wind that is produced by the revolving armature, and also to prevent anything falling on to it, a guard is provided which passes right round and over the gap between the two halves of the frames.

In giving a similar description of the 650 k.w. alternator, in order to avoid recapitulation, it will only be of interest to point out where the design differs from that of the machine of larger output above mentioned.

The chief requirement of this machine is to take the morning loads where a plant of larger output would be working under very uneconomical conditions. The output of this alternator is 60 ampères at 10,000 to 11,000 volts at 250 revolutions, with a reserve of about 20 per cent. for overload.

The wheel here being only 8 ft. 4 in. in diameter, and not having to carry so great a weight as in the above machine, is made in one casting in iron, and is secured to the shaft by the usual method of steel rings shrunk on to the boss. The shaft is 15 in. in diameter in the swell and 10 in. in diameter in the journals. Lubrication is carried out on the same principle as already described.

The armature consists of 36 bobbins of the standard construction, but the main point of interest on this alternator lies in the method of connecting up the coils. Unlike the armature of the 1,500 k.w. machine, where the coils were connected up in two equal parallel halves, this one is arranged in series, but in such a manner that the greatest difference of potential between any two adjacent live coils is 5,000 volts, and this where the two coils in question are separated by two dummy bobbins made of hard wood.

It is readily apparent that had this armature been connected up in parallel, the difference of potential between any two adjacent turns would have been excessive; hence the arrangement in series. A reference to the diagram of winding, which we are enabled to produce by the courtesy of the *Engineer*, will make this quite clear.

In all other respects the design is similar to that already fully explained in the case of the larger alternator.

Both these alternators are driven by engines made by Plenty and Son, which have always given every satisfaction.

A SELF-PROPELLED STEAM FIRE-ENGINE.

At a time when we are constantly reading in the technical and popular Press of the alleged successful employment in America and on the Continent of mechanically driven fire-engines, manufactured by foreign firms, it is gratifying to learn that our home firms are by no means behind their foreign competitors in trying to introduce a really workable engine. Messrs. Merryweather & Sons have recently turned out from their Greenwich Road works a self-propelled steam fire-engine, which not only has proved that the idea is practicable, but the results have exceeded all that was hoped from the invention. We are enabled to illustrate the engine below, from which it will be seen that it greatly resembles the steam fire-engines in use by the Metropolitan Fire Brigade, with the addition of the propelling mechanism. The engine is of the double cylinder vertical type, bolted in front of the boiler, and supported on a strong frame. The cylinders and pumps are placed in a direct line with one another, and the motion is conveyed direct. The crank-shaft is so arranged that the pumps can be instantly disconnected and an intermediate shaft driven by means of spur gearing. This intermediate shaft is fitted at both ends with chain wheels, which drive sprocket wheels fixed on the spokes of the rear wheels of the machine by means of strong roller chains. Balance gear is provided to enable the machine to turn corners with safety. Link-motion reversing gear is also provided, enabling the engine to run backwards. When tested in London recently it was found that the engine would travel over comparatively level roads at a speed of 20 to 30 miles per hour. Its behaviour on steep gradients was very satisfactory, a speed of 10 miles per hour being attained when mounting such hills as Black-

SELF-PROPELLED STEAM FIRE-ENGINE.

heath, which has a gradient of 1 in 10. It was thus shown that any of the hills around London could be mounted with little difficulty, a result not always accomplished by horse-drawn steam fire-engines. When travelling at its greatest speed very little vibration was noticeable, and no difficulty was found in keeping one's seat either in front or on the hose-box. The steering is effected from the front, where there is seating accommodation for two firemen. A small hand-wheel actuates a vertical rod, fitted at its lower extremity with a chain wheel connected to the fore-carriage by a roller chain. The steam-regulating lever, reversing lever, and steering wheel are all placed in front, to be operated by the driver, together with a strong foot-brake. In addition to this a powerful screw-brake, operating upon the rear wheels, is provided, and is worked by the engineer standing at the rear of the boiler. Upon arrival at the scene of conflagration the engine can at once be put in gear with the fire pumps, to which the suction hose is always attached, being carried on brackets round the machine. These pumps are of the "Greenwich Gem" type, and are entirely of gunmetal, and are so arranged that access to the whole of the valves can be had by the removal of one cover. They will deliver 300 gallons of water per minute, and throw a 1-in. jet to a height of 160 ft., or several jets to a lesser altitude.

The boiler is of the same pattern as that used in the steam fire-engines supplied by the firm to the Metropolitan Fire Brigade, and is of the water-tube type. It is capable of raising steam to the working pressure of 100 lb. to the square inch in from six to eight minutes from the moment of applying a light to the fire, starting all cold. If a heater with self-locking couplings and automatic disconnection is fitted in the fire station, speed could be raised in such few moments that the engine could leave the station at full speed in from two to three minutes from the time of receiving the "call." This is not much longer than the time occupied in attaching horses, and the slight initial delay is far more than compensated by the greater speed attained on the roads. The draught can be readily regulated by adjustable doors, and the ash-pan is covered in. Stoking is done from behind, and of course can be carried on while the engine is travelling. A large hose box is fitted in front, having space for several hundred feet of hose, as well as fittings and gear. This box also forms a convenient seat for firemen.

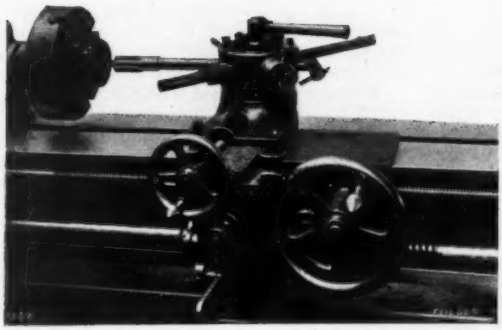
When fully equipped with fuel, hose, and a full complement of firemen, the machine weighs well under three tons, which would seem to dispose of the idea that a steam automobile must of necessity be of heavy construction if great strength and power are to be retained. The machine is so arranged that, if it is desired, horses may be employed to draw the engine, two being sufficient for the purpose. The wheels are of special construction, and have gun-metal hubs.

NEW HEAVY 12-INCH SWING ENGINE LATHE.

THE lathe herewith embodies some important new features, and taken as a whole may be regarded as a piece of mechanism that reflects the greatest credit on its designers and constructors, Messrs. Humpage, Jacques and Pederson. It has taken some time in its evolution, the patents indeed secured with regard to it being one old, the other quite recent. It has been specially designed by practical men for the rapid production of work, the arrangement of its details specially lending themselves to this end. The simplification of the various parts has been carried out to such an extent, that the operations of screw-cutting, changing of feeds, alteration of boring to turning, etc., are rendered so easy that they can be carried out perfectly by a mere lad.

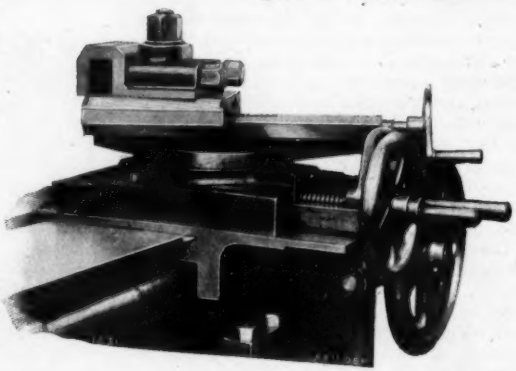
The bed, as will be seen, is of deed and rigid box section, the top being divided longitudinally except at the headstock end, thus forming two separate parts, on the front one of which the saddle is carried, the back one taking the loose headstock, a slide which acts as a size gauge and a fixed steady. The saddle is thus free to completely pass the slide, steady and loose headstock, enabling the centres to come close together, and enabling self-action or screw-cutting to be used on the shortest possible work between the centres.

The headstock is very compactly designed, being fitted with the Humpage Epicyclic gear. This gear is extremely neat and noiseless, being enclosed in the cone pulley

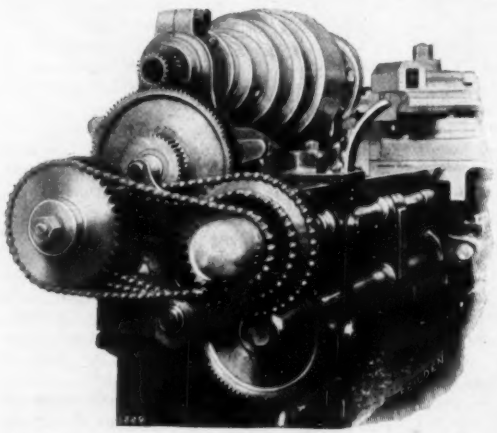


SWING LATHE: VIEW SHOWING SLIDE REST REMOVED AND TURNING HEAD PUT ON. THIS CAN BE EFFECTED IN A FEW SECONDS WITHOUT SLACKENING A SCREW.

and the whole running in an oil bath. The change from double to single gear is very rapidly effected, and when desired, the gear can be instantly disconnected, leaving the mandrel standing without stopping the counter-shaft. It is to be noted that the work done with this gearing is absolutely free from objectionable chequer and marks. The mandrel is of large proportions, with a hole through its length to take up to 1¼ in. bar for turning out studs, screws, etc., the rose being threaded internally to receive bushes for the support of the bar when boring. The ratio of the gear is 9¼ to 1, and the cone having four speeds to take a 2 inch belt, in combination with the two speeds of the countershaft, gives a uniform gradation



SWING LATHE: VIEW OF COMPOUND SLIDE REST.



SWING LATHE: VIEW OF SELF ACTION FEEDS WITH COVER REMOVED.

of sixteen speeds through double or single gear.

The loose headstock is made to slide on the back portion of the bed and may be secured in any position by means of two hand-screws which draw it up against an inclined face, thus always securing true alignment; it can also be set over for slight taper turning. The movement of the barrel, which never leaves its full bearing in the head, is effected by the hand wheel on the top which is so arranged as to clear the compound rest and hand of the operator.

The saddle, carried on the

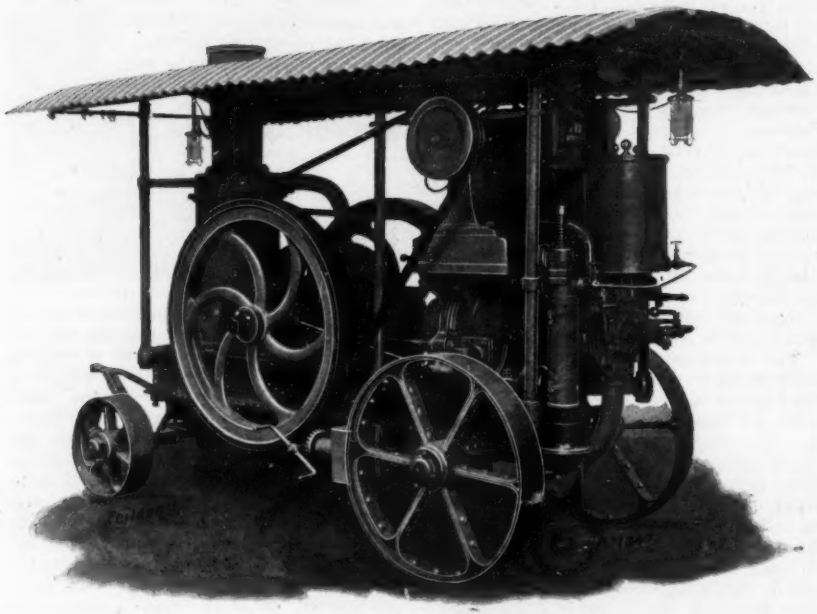
front part of the bed, is provided with extra large wearing surfaces. Three rates of feed are provided, viz., $\frac{1}{80}$, $\frac{1}{40}$ and $\frac{1}{20}$ of an inch advance with each turn of the mandrel. A lever fixed in front of the bed gives the changes from one feed to another without the operator being required to change his position, the intermediate positions of the lever throwing the feed out of action. The saddle may be fixed in any position whilst surfacing, the surfacing screw being arranged with a hand wheel and pointer for screw-cutting or turning which is graduated to $\frac{1}{1000}$ of an inch. The entire compound rest may be slided off and on the saddle without slackening a single screw, and is interchangeable with the turret boring head, which can be supplied as an accessory.

The screw-cutting, arranged independently of the feed, is effected by a long shaft fixed below the feed screw, which is geared with the headstock in a constant ratio of four to one. Short sleeve screws having threads four times as coarse as the thread to be cut are slid on this shaft and may be fixed in any required position. A half-nut of corresponding pitch is carried on a lever fixed to the saddle, which is so arranged as to automatically throw out of gear at any pre-determined point, and, at the same time, the tool can either be automatically withdrawn or left to cut a circular groove at the end of the thread. In consequence of this arrangement, odd or even pitches can be cut, and the nut put into gear anywhere without calculation or marking and the use of change wheels entirely dispensed with. The same arrangement applies to the cutting of internal threads.

With regard to the Compound Slide Rest, the intermediate swivel part is indexed with degrees. The top slide is provided with a steel rack engaging with a short screw which provides a much larger bearing surface than by the ordinary method, and prevents the entry of dirt and cuttings. The tool can be tilted and adjusted vertically without packing, and further, can be adjusted horizontally and swivelled without altering the previous setting. An adjustable gauging bar is also provided, which passes through the base slide, and can be set for turning and screw-cutting work of any diameter. The travelling steady slides on the saddle, no packing blocks being required, and can be adjusted so as to take any size of shaft up to 3 inches diameter. Three pulleys are provided on the countershaft, one fast and two loose, the latter of which run respectively at 150 and 208 revolutions per minute. The arms carrying the striking bar can be swivelled to any angle to receive the belts.

PORTABLE OIL ENGINE SEARCHLIGHT PLANT.

Four sets of the above were supplied to the order of H.M. War Department for use in the present campaign in the Transvaal, from the Campbell Gas Engine Co., Ltd., of Halifax. They are to be used for searchlight purposes at night, and during the day it is intended to use the current from the dynamo for the purpose of running electrically driven pumps for supplying water for the various uses in the field. The engines themselves are of the ordinary "Campbell" oil engine type, with the exception that everything is reduced as far as possible in weight, so as to render each set as light as possible, consistent with the work it is intended they should perform. Each engine is a 10½ b.h.p. constant working load, but they are capable of developing a maximum b.h.p. of 12½. The wheels and crank shafts are carried on steel channels, which are plated over the top and the bottom so as to form the water-tank. On the top of the cylinder is formed a platform to receive the dynamo; this platform is machined and grooved to take the place of sliding rails, so that the dynamo can be moved along to tighten the driving ropes. The output of the dynamo at 790 revolutions per minute is 80 volts 75 ampères. The plant is capable of taking an overload of 25 per cent. The dynamo is of the shunt wound type usually made by the Electric Construction Co., Wolverhampton, who were the sub-contractors for all the electric apparatus to the designers and makers of the complete plant. On the front of the truck is carried a water cooler; the water leaving the cylinder jacket is forced to the top of the cooler and sprayed on a series of cooling plates. The blast from the exhaust to the engines is utilised to create a draught of air from the bottom of the cooler through the falling water. It was found by actual experiment that the water leaving the cylinder jacket at a temperature of 180 deg. Fah. had its temperature reduced by the cooler to 85 deg. Fah. The



PORTABLE OIL ENGINE SEARCHLIGHT PLANT SUPPLIED TO H.M. WAR DEPARTMENT.

quantity of water carried is 48 gallons, which is sufficient for a ten hours' continuous run at full load, without any additional water being required. The oil supply is carried in the tank at the rear of the car above the end of the engine cylinder. It contains sufficient oil for a seven hours' run at full load.

Protection from the weather is afforded by a galvanised sheet steel roof carried on tubular columns from the truck. In addition to this tubular, rails are carried on the underside of the roof, and these rails carry hooks, from which are suspended tarpaulins, entirely enclosing the plant, whether working or stationary. The dynamo, as will be seen, is driven by three ropes, and these gave satisfaction during all the trials that took place. The total weight of the plant in working order is $3\frac{3}{4}$ tons. This is entirely a new development on the part of the War Office to supply such plants in actual warfare, and it may lead in the near future to still further developments.

REFRIGERATING PLANT FOR S.S. "CALEDONIAN."

DESIGNED, CONSTRUCTED, AND FITTED BY THE LIVERPOOL REFRIGERATION CO., LTD.

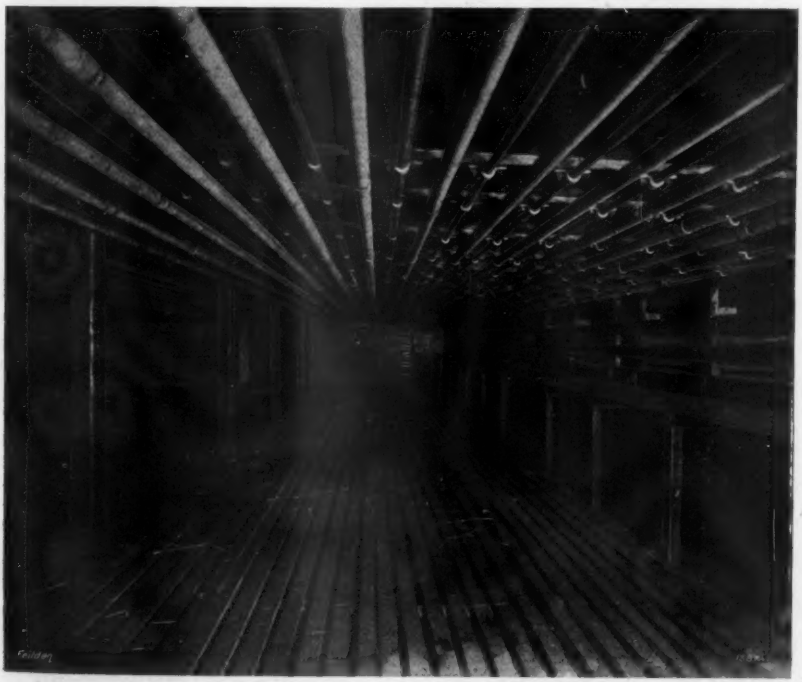
THE plant is constructed on what is known as the Ammonia Compression and Brine Circulation System, which is well adapted for the maintenance of the absolutely steady temperatures so essential to the carriage of chilled beef.

The ammonia compressors—two in number—are worked off the tail rods of the high and low pressure steam cylinders, as shown in the accompanying engraving. By an arrangement of the valves on the steam and exhaust pipes, this compound steam engine, can, if necessity should arise, be worked as two perfectly independent high pressure engines, indeed throughout the whole plant, the designers have kept in view the desirability of safeguarding against all possible breakdowns, by making

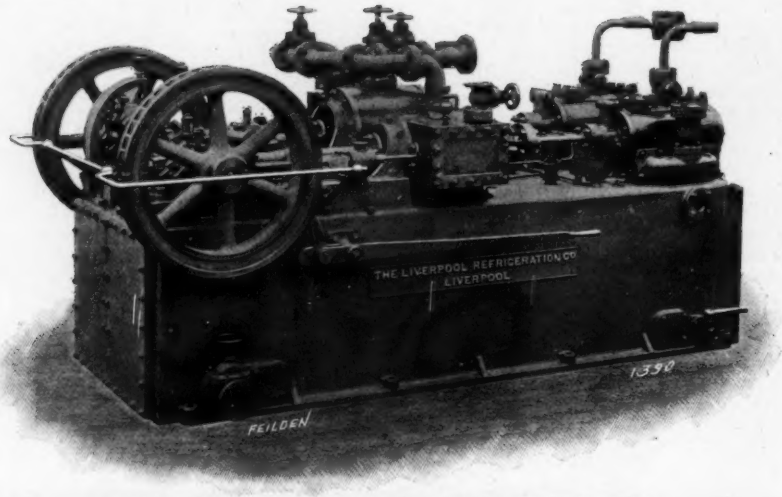
all similar parts interchangeable, all essential parts duplex, and the whole plant of such refrigerating power, that one half of this complete duplex machine is sufficient to maintain the desired temperature in the cold chambers. The ammonia condenser coils are contained in the deep box bed on which the engine and compressors are fixed and form two complete and independent condensers. The refrigerators—two in number—consist of heavy mild steel shells, containing a number of concentric coils of lapwelded tube, tested to 2,000 lbs. per square inch. The vaporisation of the liquid ammonia takes place inside these coils, which are surrounded by the brine to be cooled. After cooling to a low temperature, the brine is pumped by a duplex brine pump from the refrigerator through the various sections of the brine pipes arranged on the roof, sides, and ends of the chambers in which the beef is hung, and back again to the refrigerator to be again cooled.

From their great experience in this special branch of refrigeration, The Liverpool Refrigeration Co., Ltd., have been enabled to so arrange the different sections of the brine piping in the chambers, each having its controlling valve and thermometers in the machine room, in such a manner that an absolutely even temperature can be maintained in all parts of the chamber: or if necessary, the chambers can be subdivided by insulated bulkheads, and temperatures varied to suit requirements of the goods carried. All cold parts of the plant in the machine room are enclosed in an insulated chamber to prevent as far as possible, losses due to radiation.

The insulation of the chambers consists of two thicknesses of best American Hair Felt between four thicknesses of tongued and grooved boards, and Willesden water-



REFRIGERATING PLANT FOR S.S. "CALEDONIAN": INTERIOR OF A COLD CHAMBER.



REFIGERATING PLANT, S.S. "CALEDONIAN": ENGINE AND AMMONIA CONDENSER.

proof paper, backed up by 6 in. of dry sawdust. The Refrigerating power of the plant is equal to the melting of 12 tons of ice per 24 hours at 32° Fah. Our illustrations show the machine with compressors, engine and ammonia condenser, and also an interior of a cold chamber, similarly fitted, and showing meat rails, brine pipes, and tables in position.

HIGH-SPEED ENGINE AND ALTERNATOR FOR THE HARROGATE ELECTRIC LIGHT WORKS.

On page 79 is illustrated a simple high-speed engine coupled direct to an alternator, just completed for the Harrogate Electric Light Works, the following particulars of which we are enabled to present by the courtesy of Messrs. J. and H. McLaren, of Leeds, the makers of the engine, and Messrs. Siemens Bros. and Co., Ltd., who supplied the alternator.

The main object kept in view in designing this engine was to secure a simplicity in the working parts, and to provide a machine which would develop its full power continuously with the least possible wear and tear and attention. That this result has been achieved may be gathered from the fact that an engine constructed on similar lines and supplied twelve months ago to the Corporation has shown so consistently good performances as to determine the Corporation to place the present order.

The engine is of the enclosed type, and develops a power of 600 i.h.p. at a speed of 333 revolutions per minute. The three cylinders of 16 in. by 22½ in. and 32 in. in diameter respectively by 12 in. stroke are inverted, unjacketed, and are each fitted with McLaren's balanced trick slide valves.

The three engines are practically independent of each other, and the high-speed shaft governor, which has worked so successfully on electric lighting engines turned out by Messrs. McLaren, acts only on the high-pressure valve.

The whole of the working parts are lubricated by oil pressure, and the engine is fitted with two complete and duplicate lubricating arrangements worked off separate pumps, each bearing being supplied by separate pipes, so that in the event of either pump choking or getting out of order the other will continue working.

The crank shaft is 6 in. in diameter, and a heavy flywheel is mounted thereon to ensure steadiness.

Exhaustive tests recently made show that the steam consumption is under 22 lbs. of steam per k.w. hour at full load, a result

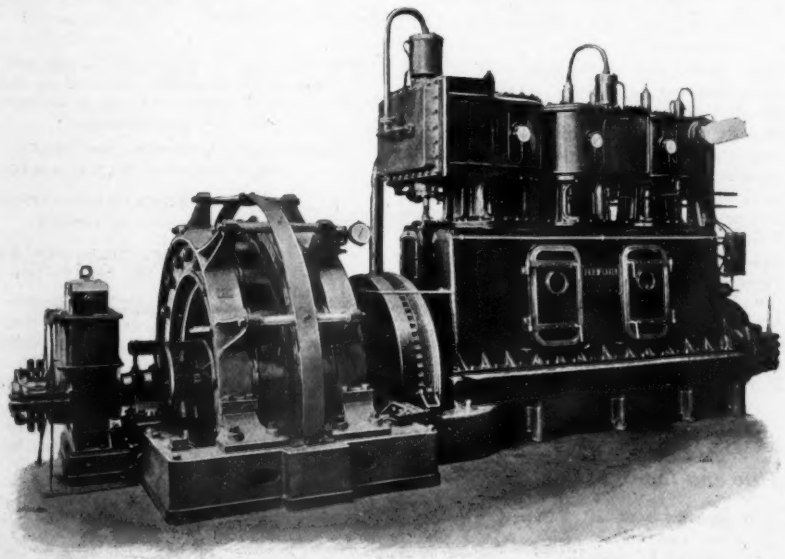
which, when taking into consideration that the initial steam pressure available is only 130 lbs., and that the cylinders are unjacketed, must be acknowledged as being very satisfactory.

The alternator to which the McLaren engine is directly coupled is of the Siemens w. 18/6¾ type, without a revolving armature, the cores of the armature coils being free from iron. There are 16 bobbins on the armature and 32 field poles.

The output, when running at a speed of 333 revolutions per minute, is 150 ampères at 2,000 to 2,100 volts, the frequency being 50 complete periods per second ; and the machine, which will stand a 20% overload, has a direct coupled exciter of the Siemens h.b. type.

CENTRAL WELL BUCKET-LADDER DREDGER.

For the deepening of the Buffalo River, and also for the improvement of the approaches to the Port of East London, Messrs. Wm. Simons & Co., Limited, of Renfrew, despatched towards the end of March, after the vessel had undergone very successful steam and dredging trials on the Clyde, the powerful new central well bucket-ladder dredger named *Success*. The vessel has been constructed under the direction of Messrs. Coode, Son & Matthews, civil engineers, Westminster, and is the second dredging vessel constructed by Messrs. Simons for the East London Harbour Board. The *Success* is classed at Lloyds, and her propulsive power is supplied by one set of tri-compound surface condensing engines, and one mild steel boiler for a working pressure of 160 lbs. per square inch. Auxiliary plant of the latest type, including independent centrifugal pump, feed heater, filter and evaporator is attached to the engines. The dredging buckets have a total lifting capacity of 500 tons per hour, the maximum dredging depth being 36 feet below water level. Steam steering gear, electric light, bow and stern winches, and all the latest appliances for a vessel of this type are fitted on board. Comfortable quarters are provided for the officers and crew. The arrangements of dredging gear permit of the vessel cutting her own floatage through banks and shoals. Owing to the war in



HIGH SPEED ENGINE AND ALTERNATOR FOR THE HARROGATE ELECTRIC LIGHT WORKS

CENTRAL WELL BUCKET-LADDER DREDGER "SUCCESS."

South Africa and the urgent requirements of the harbour authorities at East London in connection with the transport of Her Majesty's troops, the builders have run their engineering departments night and day to expedite the construction of the vessel. It is interesting to note that it was entirely through the work accomplished at Durban, Natal, by the sand pump dredgers *Octopus* and *Walrus*, and other dredging vessels constructed by Messrs. Simons, that the larger transports chartered by Her Majesty's Government for the conveyance of troops to South Africa, were able to cross the bar and to come alongside the wharf at Durban.

Title and Index to Vol. II.

A complete Index and Title-page to Volume II. are now in the Press. A Set may be obtained by remitting 3d. in stamps to the Publisher.

THE contents of the anniversary (August) issue of ***FEILDEN'S MAGAZINE*** will be of the highest technical character and value. Among the many important subjects treated will be the following :—

MODERN STONE-WORKING MACHINERY,
by M. Powis Bale, M.I.M.E., A.M.I.C.E.

RAILWAY ROLLING STOCK OF HIGH CAPACITY,
by J. D. Twinberrow, A.M.I.C.E.

THE UTILIZATION OF TIDAL AND WAVE ACTION FOR THE PROTECTION OF FORESHORES,
by R. G. Allanson-Winn, C.E.

THE SIMPLON TUNNEL,
by G. Glaser, Ph.D.

PNEUMATIC TOOLS AND APPLIANCES,
by Ewart C. Amos, M.I.Mech.E.

Special EXHIBITS AT PARIS, &c. &c., &c.

In view of the anticipated large extra demand for this exceptional issue, the proprietors advise all those whose subscriptions fall out with the current (July) issue to send in their renewals without delay or copies cannot be guaranteed. The necessary form will be found in this number.

A New Industry in Great Britain.

Official Opening of a Pneumatic Tool Factory at Chippenham.

(By Our Special Commissioner.)

Mr. John P. O'Donnell, M. Inst. C.E., M. Inst. Mech.E., M.Am.Soc.C.E., M.Can.Soc.C.E., Fel.Chart.Inst.P.A., &c., is well known as an expert in Railway Signalling. He served his time with Messrs. Stevens and Sons, Engineers, of London and Glasgow, and was three years Assistant Signalling Superintendent to the Lancashire and Yorkshire Railway Co., afterwards transferring his services to the London and North Western Railway Co., where he was for five years in the engineers' department. During this latter time he designed and carried out the installation of the signals at Waterloo Station, at that time the largest in the world.

In December, 1894, he, in conjunction with his partner, Mr. Evans, started the large signalling works at Chippenham, Wilts, under the name of Evans, O'Donnell and Co., Ltd.

Mr. O'Donnell is the author of, among other works, several papers on railway signalling, including No. 17 of the Four-Track Series of the Pamphlets of the New York Central Railway, and has delivered a number of lectures before the American Society of Civil Engineers.

Mr. O'Donnell not long since acquired the British and Colonial patents of the "Little Giant" Pneumatic Tools, and in conjunction with earnest coadjutors promoted the International Pneumatic Tool Co., Ltd., whose works at Chippenham, recently opened, form the subject of this article.

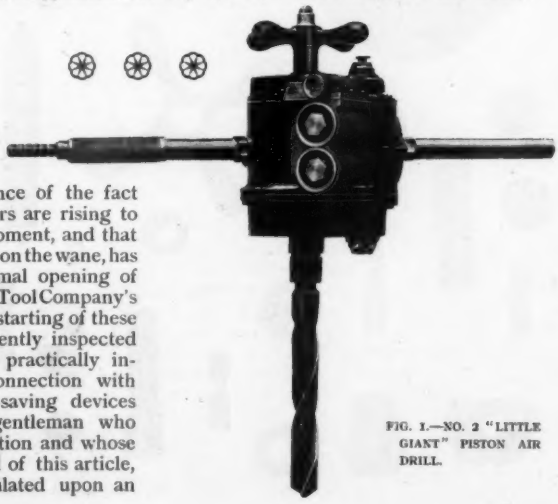


FIG. 1.—NO. 2 "LITTLE GIANT" PISTON AIR DRILL.

No more striking evidence of the fact that British engineers are rising to the needs of the moment, and that British enterprise is not quite on the wane, has been given than by the formal opening of the International Pneumatic Tool Company's works at Chippenham. The starting of these works, which the writer recently inspected with a distinguished party, practically inaugurates a new era in connection with the manufacture of labour-saving devices in this country, and the gentleman who is responsible for the innovation and whose portrait appears at the head of this article, is to be heartily congratulated upon an

achievement which, in our opinion, will not only redound to his credit and advantage, but to that of a very large number of our leading firms, who undoubtedly will be compelled to adopt the specialities which he is placing upon the market which, whilst reducing the cost of labour, will enable British engineers to compete even more successfully with their foreign rivals than they have hitherto done. In case this might be taken to imply that the advantage of pneumatic tools for certain work has not been fully recognised in this country, it would be well to state that their adoption in a number of representative shops has been going on for a little time, but we believe we are right in saying that most of the tools hitherto used have been either made or partly made by our enterprising cousins on the other side of the water, and in this connection it is well to note that considerable importations have taken place. It has been left for Mr. O'Donnell, however, and the far-seeing directors with whom he

FIG. 2.—PARTS OF NO. 2 PISTON AIR DRILL.

FIG. 4.—VIEW OF THE MACHINE SHOP.

is associated, to start the manufacture of pneumatic tools in this country, and on a large scale, sufficient indeed to meet all immediate requirements. It has been said —and we think with a great amount of truth — that both the Americans and Germans are more enterprising than ourselves in at least one material direction, viz., that of making known what they are doing; whilst we, as a nation, have been content to *do*, without notifying to the world in large type the full account of our *doings*. Thus it comes about that the introduction to many industries in this country of labour-saving tools and devices has quietly and unostentatiously taken place, and despite the large and increasing competition which has been put against us, we have been able fairly well to hold our own in the markets of the world. This, however, is not enough. It has been one of the main objects of this magazine ever since its inception in August of last year to largely modify the state of things which have hitherto been existing in many of our engineering shops, and with a result that has more than justified our efforts and existence, and at the same time with, we venture to assert, an accruing benefit of no inconsiderable extent to British engineers. We have consistently and persistently rammed home the fact that not only must we be alive to every new and important device and invention which our competitors are using, but that we should procure without delay, as soon as it is given to the world and its merits are made manifest, every labour-saving appliance which our rivals use to cheapen the cost of production and to obtain greater perfection in the specialities which they are forcing on the markets of the world against us. We have likewise urged the adoption of the business methods of foreign (particularly American) competitors in making known to the world what we *are* doing. Bombast is one thing, but genuine publicity is another, and the failure to recognise the distinction between these two and to act upon it with all the ingenuity and enterprise that Britishers undoubtedly possess, is answerable in a great measure for the loss of many fine contracts.

FIG. 5.—ANOTHER VIEW OF THE MACHINE SHOP.

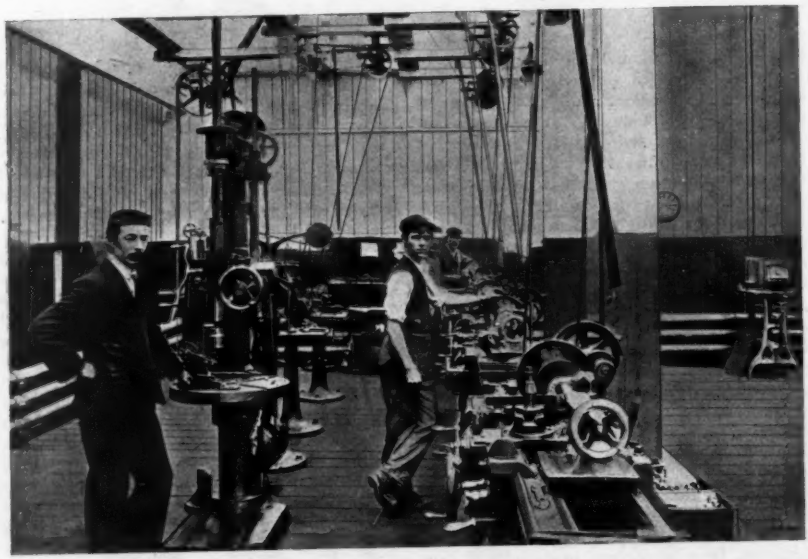


FIG. 6.—VIEW OF TOOL ROOM.

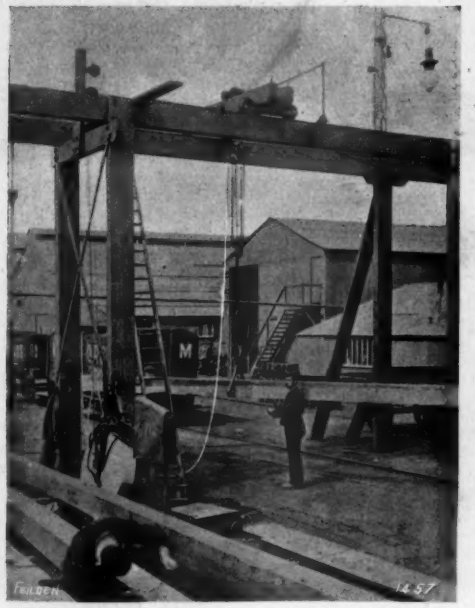


FIG. 7.—"LITTLE GIANT" CHAIN BLOCKS HOISTING TIMBER.

The immense advantage of the use of machinery over hand labour has probably never been more fully appreciated than since the introduction of pneumatic tools, and this journal has taken the lead in giving prominent notice of these valuable machines. The articles now appearing in our pages from the pen of our contributor, Mr. E. C. Amos, M. I. Mech. E., have called forth a large amount of appreciative attention. We offer no excuse, therefore, in giving a description, with a number of special illustrations, of the new works we have referred to, which, as we have observed, are the first of their kind in this country, and which have just been equipped with a magnificent plant of the most modern machinery for the manufacture of pneumatic tools of every description. Those who are familiar with the starting of new works, and particularly when the plant is of special construction, will be well aware of the magnitude of such an undertaking, and it is very creditable to all who have been concerned in this enterprise that, in a comparatively short space of time, the works have been put in a position to meet the demand which is now being made upon them, although—and it is a fact worth noting—in view of the increasing popularity of pneumatic tools, it appears very likely that the already extensive works will soon have to be enlarged.

In the articles now appearing in this Magazine our contributor has technically described the principal machines which are now being manufactured by the International Pneumatic Tool Co., Ltd., at Chippenham, and which have been happily christened "Little Giant" tools. Reference, therefore, will be more particularly directed to the works and some of the apparatus employed in their manufacture. It may be interesting, however, to mention one tool in detail as shown

FIG. 8.—"LITTLE GIANT" CHAIN BLOCKS.

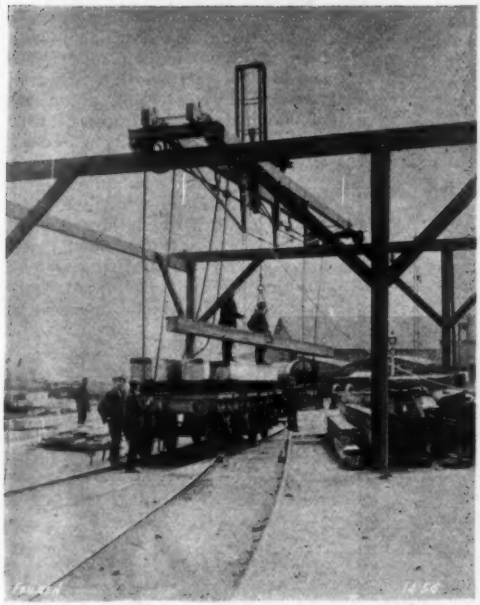


FIG. 9.—INVERTED HOIST MOUNTED ON TRAVELLING CRANE.

by the engraving (Fig. 1) appearing at the commencement of this article, viz., the "Little Giant" No. 2 Piston Air Drill, all the parts of which are shown in our illustration at Fig. 2. From this it will be at once appreciated why it is that such special machinery is required in the construction of these tools. In the first place, all parts are interchangeable, and the whole machine, including the casing, is made of steel. Again, since weight, or rather the absence of as much weight as possible, is a great desideratum in all portable machines, every part is reduced to the smallest size possible consistent with strength. As one interested observer happily put it when the writer had the privilege of being present at the recent practical demonstration at Chippenham, in the case of pneumatic tools, "If Mahomet cannot be brought to the mountain, the mountain can be brought to Mahomet."

As an instance of what they are capable of doing, one of the tools inspected by us will drill up to $\frac{9}{16}$ in. dia. in steel, and weighs complete only 8 lbs., whilst a larger size, capable of drilling 1 in. dia. holes in toughened steel armour plate, weighs only 9 lbs., and yet a larger size, to drill up to 3 in. dia. holes in metal, weighs 45 lbs. At first sight it may appear that strength is sacrificed to lightness, but it is a noteworthy claim by the makers that although these machines are largely placed in the hands of inexperienced mechanics, they seldom go wrong, and the manufacturers, moreover, have sufficient confidence in their construction to guarantee them against repair for twelve months. The particular machines under reference have four cylinders, with their corresponding pistons, &c., so that there are

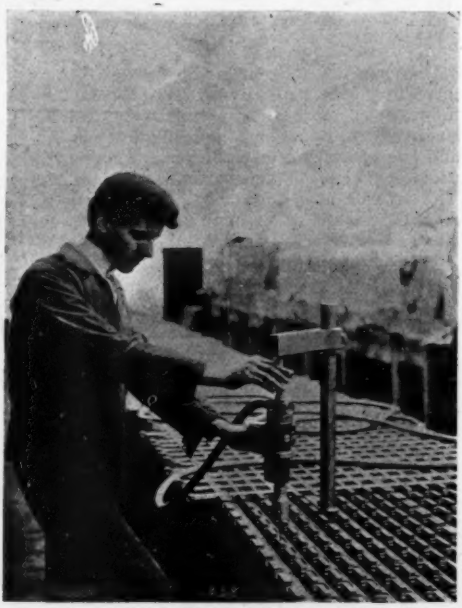


FIG. 11.—DRILLING SIGNAL LOCKING CHANNELS WITH NO. 3 PISTON AIR DRILL.

FIG. 10.—FETTLING CASTINGS WITH PNEUMATIC HAMMERS.

really considerably more parts in each complete machine than are shown in our illustration, since duplicate parts are not presented there. A large number of the parts are hardened, which involves grinding, and the whole machine is really a complete engine confined in a space never imagined possible a few years ago. Such a result is, of course, due to the enormous improvements effected in the construction of the machine tools now in use.

It may be mentioned that one of these machines (No. 2 size, which weighs only 19 lbs.) is now being used for drilling holes 1 in. dia. through toughened steel armour plates as used by Messrs. Vickers, Sons and Maxim. We learn that this celebrated firm were at first somewhat sceptical as to the ability of the machine to perform the work required, but it was found on application that not only would it do what was stated for it, but that the time occupied to drill a 1 in. hole, $4\frac{1}{4}$ in. deep, was only $9\frac{1}{4}$ minutes, which is a further remarkable illustration of the great advantages possessed by these machines for drilling work in position as compared with hand-drilling, which, previous to their adoption, was largely necessary.

Reverting to the works, the first illustration of these (Fig. 4) is taken in the machine shop, in the left foreground of which will be seen a full automatic screw machine for producing to gauge the various pins, screws, studs, bushings, and other turned work used in the construction of the pneumatic tools under review. The machines are by Herbert, of Coventry, and have already been fully described in the Machine Tool articles which recently appeared in this journal. It is worthy of note in these days, when American tools are finding their way into most of our engineering shops, that nearly all the machines in this new factory are of British construction.

The machine seen on the right in the illustration just referred to is a No. 2 Vertical Milling Machine by the same maker, fitted with circular and compound takes, all motions being automatic.

FIG. 12.—BORING HOLES IN TIMBER WITH REVERSIBLE DRILL.

Another view of the same shop (Fig. 5) is also shown. This shop contains, besides the machines referred to (of which there are several of a kind), various sorts of automatic and wire-feed Capstan Lathes, Chasing Saddle Lathes, Sensitive Drills, Universal Milling Machines, Emery Grinders for truing up hardened parts, and other special machines. It will be readily understood that in the construction of these pneumatic tools, the highest grade of special machines is necessary and that heavy machines of ordinary type are of little use. Special jigs and attachments for boring out the cylinders, both of the drills and hammers, play a very important part, and consequently the tool room, which is shown in the next illustration (Fig. 6) is a very extensive department. This room always forms a very valuable adjunct to every up-to-date shop, and is probably never so important as in works of this description.

The next illustration (Fig. 7) is taken in the extensive yards adjoining the works, and shows a set of "Little Giant" Chain Blocks hoisting timber into trucks. A detailed view of the hoist is shown at Fig 8.

The demand for this type of pneumatic appliance appears now to be very great, as it is so easily adapted to existing forms of lifting gear, and obviously effects a very great saving in labour. It simply consists of a reversible 4 cylinder piston type drill attached to a pair of differential pulley blocks, and the action of lifting and lowering is performed by merely pulling the small chain. It is instantaneous in its reversal, and the load can be left suspended for any length of time.

The second yard view presents another method of lifting timber where greater speed is required for lighter loads. This shows an inverted hoist (Fig. 9) working in combination with snatch gear and mounted on a travelling crane. This is quicker in action than the blocks, and for certain purposes is found to be very convenient, and is probably more economical in consumption of air.

Before the introduction of pneumatic tools, most castings, with the exception of the small size, were all chipped and fettled by hand, and in shops that have not yet adopted automatic tools, castings are still so treated. It has been found, however, that great saving can be effected by using a pneumatic hammer for chipping (Fig. 10) and a circular wire brush fixed to the spindle of a drill for cleaning off the sand, &c.

Another view of a portable drill in operation is shown in Fig. 11. This illustrates a No. 3 "Little Giant" Piston Air Drill of the breast type fitted with screw-feed attachment and used for drilling signal locking channels. These holes were previously drilled by hand ratchet braces, and the saving effected by the use of the pneumatic drill is apparently very considerable.

For all kinds of wood boring, the reversible pneumatic drill is undoubtedly a great labour saver. Fig. 12 shows an operator drilling holes in timber for signalling apparatus. Fig. 13 presents a novel application of a pneumatic hammer and one that undoubtedly secures better work at less cost than hand labour. It illustrates the operator rivetting studs in cranks for signal work, the discs or cranks on the left

FIG. 13.—RIVETTING STUDS IN CRANKS FOR SIGNAL WORK.

FIG. 14.—DIE SINKING FROM HARD STEEL BLOCKS.

show the work finished, whilst those on the right are waiting for the wrought-iron pins to be rivetted to the cast-iron discs.

Fig. 14 shows another very useful application of a hammer. In this view the operater is die-sinking from hard steel blocks, and the saving effected here must also be very great.

Did space permit, many other applications of machines in operation might be illustrated, but enough has been shown to indicate the immense utility of pneumatic tools.

T. W. Ford, M.I.Mech.E., A.M.I.C.E. was instrumental in obtaining the option on the patents. He spent some time in the United States of America investigating the business of the Standard Pneumatic Tool Co., and negotiated the option which resulted in the formation of the International Pneumatic Tool Co., Limited. He went out to inspect some of the American locos for some of the British railways, and was present at the Master Mechanics' Convention at Old Point Comfort, Virginia, where he had very special opportunities of making reports on Little Giant tools compared with all other pneumatic tools in America, all the Companies being well represented by exhibits. His name is familiar probably to the generality of locomotive men in this country. He started business for himself three years ago in Westminster, and after practising twelve months joined Mr. O'Donnell as partner in Messrs Ford and Co.

In addition to the machines already referred to, the company are manufacturing percussion pneumatic rivetters, both of the yoke and hand type, also compression rivetters (Fielding's patent), pneumatic blow-off cocks, flue cutters, and flue rolling machines, stay-bolt cutters, and other pneumatic tools and appliances. The works are fitted with a complete installation for the supply of compressed air, and have every facility for rapidly turning out the best kind of work possible, and at a price that will very favourably compare with the American machines.

Before closing this article we feel it our duty to record our appreciation of the courtesy which Mr. O'Donnell, his co-directors, and Mr. Ford, the able London manager, have extended towards FEILDEN'S MAGAZINE and its representatives. Every facility has been placed at our disposal for inspection and investigation, and it is with the liveliest feelings of gratification that we are enabled to present our readers with the particulars now given, and the illustrations accompanying which have now only appeared for the first time, and, in fact, were taken by the advice and in co-operation with our Commissioner. It might be of interest to mention that, acting with Mr. O'Donnell in the directorate of the International Pneumatic Tool Co., Ltd., are such well-known gentlemen as Mr. W. H. Craven, M.I. Mech. E., of the eminent Manchester firm of machine tool makers ; Mr. Alex. Spencer, M.I. Mech. E. ; George Spencer, Moulton, and Co., of London and Bradford ; Mr. John Pettigrew, managing director of Messrs. Robt. Ingham, Clark and Co. ; Mr. D. E. Norton, a director of Evans, O'Donnell and Co., London and Chippenham, and others.

In conclusion, it is probably not too much to say that the opening of these works and the starting of what is largely a new industry in this country is a unique occasion in the history of engineering, and in this connection it might be well to mention that, though it is true that our American friends have up till now largely secured the monopoly of this class of machine, the Patent Office will show that our inventors were working on similar lines many years ago ; and whilst it is not intended to detract from the value of the American productions, it is satisfactory to know that the machines are now being constructed in this country by British engineers, by British skill, and with British capital.

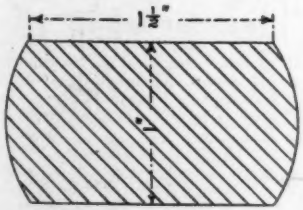
WORKSHOP PRACTICE

The purport of this section of FEILDEN'S MAGAZINE is to give the skilled mechanic in our great industrial establishments an opportunity of bringing his practical ideas and experience into print. Inventive capacity and careful thought on the part of the workman is what we desire to encourage and foster. To this end we invite skilled mechanics, foremen, under-foremen, and heads of departments, to communicate practical suggestions, which, if accepted, will be suitably paid for. Wherever possible, drawings should accompany the contribution; rough sketches will suffice, as, when draughtsmanship is at fault, we will do all that is necessary to render them fit for reproduction. Nothing will be too poor for a careful inspection. It will be seen that those contributions which appear in this section show distinct merit, and are both interesting and instructive.

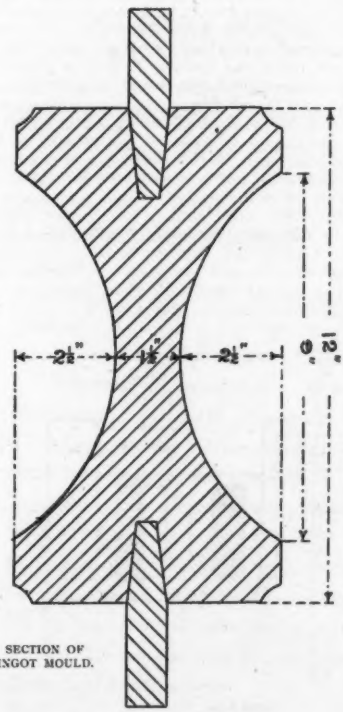
A Revolving Ingot-Mould.—The sketch represents a new design of an ingot-mould, which possesses many advantages over the regular flat pattern in every-day use. First, it obviates the use of tongs when emptying hot ingots; second, it saves space, 20 ingots only occupying the space of 10 of the ordinary pattern; third, it does not draw damp, being raised from the ground; fourth, with a series of these ingot-moulds a heat of metal can be poured and emptied in much less time, thereby saving waste of metal through oxidisation. The two ends *E.E.* are of mild steel flattened batswing shape on one end, and cast into the ingot-moulds which are supported on two trestles with flat checks wide enough to allow for the turn over of the ingot. At *H.* there is a $\frac{1}{2}$ in. hole for the pin *P.* with which the ingot mould is canted over.

PIN.

"BRASSEY."

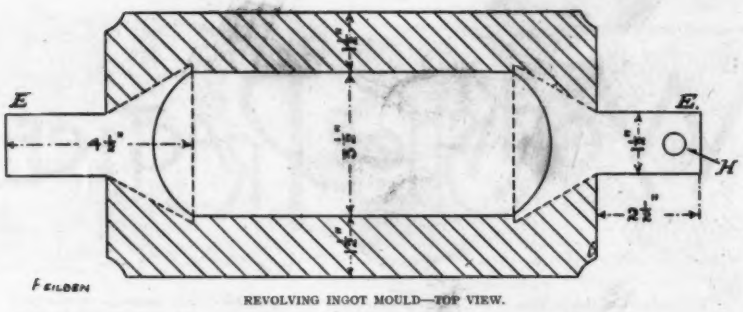


SECTION OF ENDS.



SECTION OF INGOT MOULD.

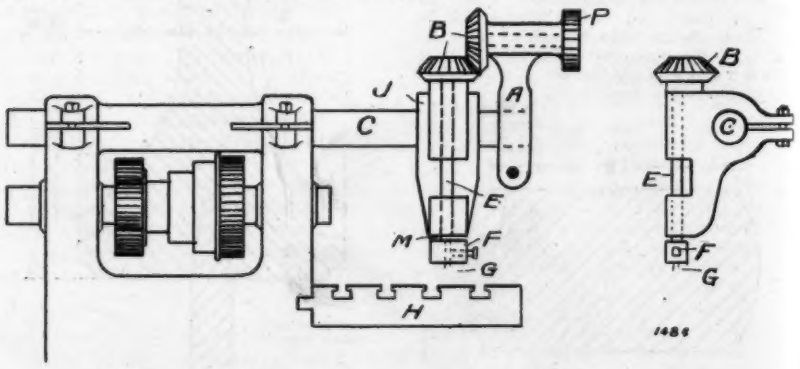
DETAILS OF REVOLVING INGOT MOULD.



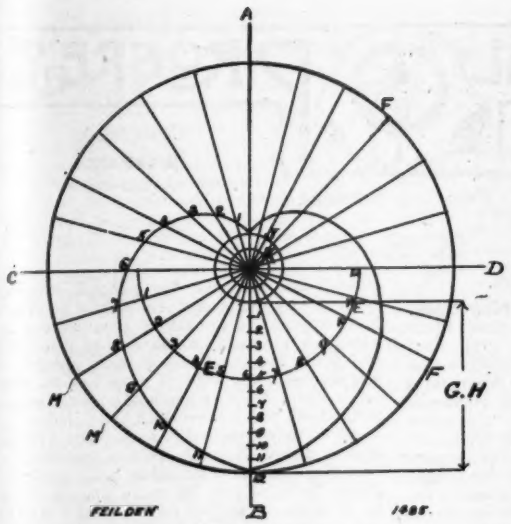
REVOLVING INGOT MOULD—TOP VIEW.

Improvising an Ordinary Horizontal Milling Machine for Vertical Milling on Light Work.—The following sketch shows a small useful attachment which can be applied for doing light vertical milling, such as cutting keyways in small shafts and lathe spindles, &c. The writer, who had no vertical milling machine in his workshop, applied this improvised motion with success. As shown by sketch, the apparatus is secured round the arm of the horizontal milling machine (*C*). *B* are bevel wheels which drive the spindle *E* with a pulley *P*, which can be driven from any convenient place on the shafting. *A* is an independent bearing for the shaft of the top bevel wheel to revolve in, or if required can be cast to the other casting *J*. A ball bearing, if desired, can be used at *M*, and will make the spindle *E* run easier. *F* is the end of spindle into which is secured the small milling tool *G*. Of course, at the same time the milling cutter is engaged on its work the main table *H* will traverse longitudinally, and thus a sunken keyway, &c., can be cut any length. Various means can be employed for making the apparatus rigid and prevent it slipping round the arm *C*, and fit for the nature of the work required to be done.

Setting Out a Heart-Shaped Cam. — The heart-shaped cam plays a very important part in certain classes of machinery, and could be used to advantage where a backward and forward motion is required—for instance, as a planing machine table traverse on a small scale. But in this motion, which has a slow traverse, there must be a dead stop, if only for a very short time, as the table or travelling object reaches each end of its stroke, and further, when the return stroke starts, there is generally a sudden shock. Now, both these points are very objectionable, and where a motion is required without a shock or stop at the end of stroke, the heart motion is an ideal one, but the writer ventures to say that very few mechanics could set out a heart cam, and the following description should therefore be worth a place in any mechanic's pocket-book. Draw a circle *K* (the diameter of shaft upon which the cam will be mounted); then another *J*, which represents the outside diameter of boss. Let *GH*



HORIZONTAL MILLING MACHINE FOR VERTICAL MILLING.



SETTING OUT A HEART-SHAPED CAM.

represent in inches the extreme travel of article actuated by cam, and divide this distance in equal parts, any number, say 12, on the vertical line *AB*. Now draw an arc *EE* with any radius, but for convenience midway between *J* and *F*. Divide this arc into as many divisions as the lower part of *AB* (12). Then draw a line through each point where the division is made and the centre and radial lines *MM*, &c., will be the result. Now go round the curve of the heart, and it will be readily seen how this is arrived at. No. 1 (on the curve of the heart) is the same distance from the centre as is No. 1 on *AB*; No. 2 and all other numbers exactly the same distance from centre as their corresponding numbers on *AB*. So that when these distances have been pricked off the lines *MM*, &c., a line drawn through them all will represent the exact curve of heart. Of course, the more divisions in *AB* and consequently *EE*, the truer the curve will be.

Breaking Up Large Castings. — A quick method of breaking up large castings, where the usual heavy appliances are not obtainable, is as follows :—Take, for example, the case where old and heavy machinery has to be pulled out, and where very often the parts are so corroded with age that they cannot be detached except by breaking them. The usual method when the sledgehammer is not heavy enough to break the metal is to drill a number of holes with the ratchet brace, and then use a chisel or drift to sever the metal between each hole, thus splitting the part in two. Sometimes, as in the case of heavy bedplates and flywheels, &c., several inches of solid metal have to be drilled through before anything effective can be accomplished, and this in addition to being very laborious is a very lengthy job. But the following method will save much work and time. Drill one or two holes about 1 in. in diameter partly through the metal, after which partially fill them with water Then take a round drift or pin with a diameter slightly less than the hole, and place the same in the hole, giving it a sharp blow with a striking hammer, when the hydraulic pressure thus occasioned will split the metal readily.

CONTRIBUTORS TO THE "WORKSHOP PRACTICE" SECTION

are requested to communicate with the Editor immediately on the publication of their articles, stating full title of contribution, name and address and nom-de-plume (if any).

THE ATTENTION OF EMPLOYERS OF LABOUR

in our great industrial-engineering establishments is specially directed to the announcement under the heading "Workshop Practice." Inventive capacity among workmen is much more encouraged by the masters in the United States than in Great Britian, and the result is apparent in the many new practical ideas which come quickly to the fore in that country. Those British manufacturers among our numerous subscribers and readers who will assist us in popularising this section will be rendering themselves a real service.

INDUSTRIAL PROGRESS

ENGINEERING NOTES AND COMMERCIAL INFORMATION

FROM ALL SOURCES.

CIVIL ENGINEERING.

The New East River Bridge, New York.—The construction of the new East River Bridge, New York, which had been considerably delayed for some time owing to the lack of structural material, is now progressing in a very satisfactory way. The enormous masses of masonry which form the cable anchorages at each end of the bridge are nearly completed, and the steel work of the two towers has reached the level of the floor of the bridge. The false-work upon which the portion of the bridge between the towers and the abutments will be erected, has been put up and, providing that no futher delay occurs in the shipment of steel work from the rolling mills, it is probable that the towers and the shore span of the bridge will be completed during the present summer. Though not exactly the most beautiful, the new bridge will, at all events, be the largest and most rigid of the suspension-bridges of the world, for its entire length between terminals will be 7,200 ft. ; the length of the suspended span will be 1,600 ft., a few more feet than that of the Brooklyn Bridge, while the extreme width of the floor between the outside railings of the bridge will be 118 ft. Provision will be made for four trolley tracks and two elevated railway tracks, all of which will be carried between the two stiffening trusses, 50 ft. deep, which will run the entire length of the bridge from anchorage to anchorage. On the outside of these trusses, carried upon a cantilever extension of the floor beams, will be two 18 ft. roadways. Between the trusses and above the trolley tracks will be two bicycle tracks, each of about 8 ft. in width, and two 12-ft. promenades, there being a promenade and a bicycle track on each side of the centre line of the bridge.

The Panama Canal.—The more obstacles are discovered in the way of constructing the Nicaragua Canal—and to the political difficulties has been added the finding of quick sands in the lower course of the San Juan river—the more revives the interest in the resumed excavations of the Panama Canal. The company carrying on the work at present has almost entirely reconstructed the original scheme. While the former project required the use of five locks with an average fall of about ten metres, a length of 118 metres, and a width of 18 metres ; and while the canal was to have a depth of 8·25 metres, and a width of 22 metres, the new scheme provides for a depth of 9 metres, which is the depth of the North-East Sea Canal, and a width of 30 metres, and in some places even 34 metres, measured on the bottom, and requires only four locks of a maximum fall of 9 metres. These locks will be far more spacious than those of the old project, as their length is to be 225 metres, and their width 25 metres. The feeding will be effected, as originally planned, from the Chagres River ; and a large reservoir, and besides a lake, of an area of 5,500 hectares (13,600 acres), through which the canal will pass, are to be erected. There will not be required many alterations in the ports of Aspinwall or Colon, while at the Panama terminus matters are at present fairly satisfactory ; but for the erection of additional power-plant, dykes, locks, railway deviations, excavations, &c., a further outlay of about £20,000,000 will be required, this sum including the amount of £2,000,000 for "unforeseen" expenses. It would not be surprising, however, if even this estimated outlay should have to be considerably increased before the completion of the work. According to the original project the canal was to be finished in 1890, at present another ten years are demanded by experts for the completion of the work.

√ Drawbridge Operated by Gasoline Engine.—According to the *Railway and Engineering Review*, published at Chicago, the Chicago and North Western Railway put into operation in June last year a new double-track drawbridge just outside Milwaukee, Wis., over the Kinnickinnic river. The swinging of this bridge is effected by means of a gasoline engine connected by two friction drums provided with clutches. The drums are so arranged that by closing one or the other of the clutches power is transmitted to the driving shaft operating the bridge, giving the shaft either a right or a left hand direction according to which clutch is being operated, so that the bridge can be swung in either direction.

The engine is one of 22-horse power of the Fairbanks-Morse type, and is not kept running, but is allowed to stand still until a signal is given to the bridge tender. When such a signal is received, the engine is started by means of a patented self-starting device, the time required from the receiving of the signal until the bridge is set in motion being nine seconds. A fire tug is stationed just above this bridge, and it is stated that the tug can make the run from the dock, at which it is moored, to the bridge in 20 seconds, and it is therefore necessary that the bridge should be swung to permit this tug to pass within the time above given. By the use of the self-starting device the shutting down of the engine can also be effected with perfect safety, and with the same precision as the starting. The employment of this apparatus renders the gasoline engine the cheapest means for operating the bridge, as the engine uses fuel only while it is under motion, all expense ceasing when it is shut down.

The "Orograph."—A very interesting instrument, intended to take the place of the engineer's chain and level in the important work of making a profile of any road or stretch of country over which a surveying or reconnoitring party is passing, has been constructed for the engineering corps of the United States army, and is owned by a detachment of this corps stationed at Willett's Point, Long Island. According to the *Scientific American* this device consists of two substantial carriage wheels, one following the other on a single track, supporting between them, and on one side, a box of mechanism, and on the other a sort of cistern, 24 ins. in diameter, and ½ in. deep, containing mercury, and kept in a vertical position. When in operation, the "Orograph" must be held upright and not allowed to careen on either side. The instrument is a kind of perambulator in conjunction with a lever, maintained in a horizontal position by floating upon the mercury in the cistern, having a length of 24 ins., and a thickness of ½ in., with floats attached to each end and moving freely in a vertical plane on a horizontal axis. Without entering into a detailed description, it may be stated that the principles upon which the reduction of surface distance to true measurement is accomplished are that, if the surface measure of any portion of ground be called radius, the true horizontal distance will be the cosine of the angle of inclination or grade of the surface, and the difference of level will be the size of the same angle. By means of a complicated but very ingenious arrangement the data are registered automatically upon a strip of paper by means of two pencils. The pencil of altitude moves an inch for every fifty feet change of level, and the paper is drawn under the pencils at the rate of an inch for every 500 ft. in distance. The true horizontal distance can be read to tenths of a foot, and the surface distance to every ten ft. The construction of the machine was very expensive, but wherever exhibited it has been greatly admired on account of its ingenuity.

ELECTRICAL ENGINEERING.

Successful Use of Accumulators on Trunk Lines in Germany.—According to recent reports from Germany, accumulators are proving a success for the operation of single cars for passenger service on steam railroads. Encouraged by the good results achieved by running electric accumulator cars over narrow-track local roads, the railway commissioners of the Pfalz (Bavaria), decided in 1897 to install accumulator cars on two trunk lines, and as these cars have now been running since the month of January of that year, the experiment may be considered conclusive. The lines are Ludwigshafen Worms, and Ludwigshafen Neustadt an der Haardt, the one having a length of 44 km., the other of 32 km. The batteries have a capacity of 200 amp. hours, which is ample for the trip, and they are recharged at the terminal stations, which requires from 30 to 40 minutes. According to the *Street Railway Journal*, the energy consumption on a level road, the weather conditions being favourable, at a speed of 40 km. per hour, amounts to 18 watt-hours per ton kilometre of the motor train, while when heavy winds strike the cars sideways the consumption is increased to 27 watt hours per ton kilometre. As regards the life of the batteries, it is stated that the positive plates have been in service over 30,000 km., but it is added that the life of the cells is prolonged by removing the old material from the plates and inserting new active material, using the old lead grids over and over again. The weights of the motor train are: empty passenger car 11 tons, battery 9·3 tons, motors and apparatus 4·1 tons, total 24·4 tons; and as the empty trailer weighs 10 tons, the total weight of the empty motor train is about 37·4 tons, and fully loaded about 40 tons. The train operating expenses, consisting of the cost of current, oiling and polishing material, and the wages of the motorman and conductor, are about 20 pfennigs (2½d.) per train km.; this is reckoning the current for charging at 10 pfennige (1¼d.) per kw. hour, an amount which is a fair average for current supplied in a centre station. The actual cost in 1898 was 9·5 pfennigs at Ludwigshafen, and 10·3 pfennige per kw. hour at Neustadt an der Haardt. In view of the success so far attained, the commission has decided to purchase cars specially adapted for accumulator service, and to reduce the operating expenses still further.

Birmingham at last adopts the Trolley System.—The long continued deadlock in Birmingham regarding the adoption of modern methods of tramway traction, has come to an

end in April last, by the decision of the Public Works Committee to recommend to the Town Council the sanctioning of the use of overhead wires in Bristol Road, where electric accumulator cars have been running for many years. This decision was adopted by six votes to three, and the Town Council after having debated for three hours and a half the agreement between itself and the Company, submitted to it on May 1st, decided to adopt it by 36 votes against 22.

British-built Open Cars for Blackpool and Cape Town.—The Electric Railway and Tramway Carriage Works, Limited, Preston, Lancs., have recently finished an interesting type of single-dock bogie car for the Blackpool and Fleetwood Tramroad. The cars resemble, though with considerable modifications in design and construction, the American type of cross-bench open car. Their length over all, including platform, is 40 ft. 3 in., and their seating capacity is sixty-five passengers. The main frame is built of mild steel channels with an outside lining of mulmain teak secured to the channel, the whole being stiffened with adjustable truss rods, and the design and materials used give the whole car a light and elegant appearance. The equipment is furnished by Messrs. Dick, Kerr and Co., London, and comprises their standard type of motors and controllers. Twenty cars of this type have recently been taken in hand at the Preston works for Messrs. Dick, Kerr and Co., required for their contract for the Campa Bay, Cape Town and Seapoint Tramways in South Africa, together with five closed combination cars of a special type, the electrical equipments of which will be furnished by the English Electric Manufacturing Company, Limited, at Preston. This is a satisfactory sign of progress, showing that British firms are entering seriously into competition with foreign manufacturers, as regards electric traction work and are ready to take their legitimate share of colonial and foreign trade, which until quite recently has been left almost entirely in the hands of American firms.

IRON AND STEEL.

Manufacture of Malleable Castings.—The important subject of melting, casting, and annealing of iron, is treated in an article of considerable length in the *Iron Trade Review*, and from the perusal of it there remains the impression that the manufacture of malleable casting is carried on in America in a more thorough manner than in England, where the process originated. The article not only explains the theory, which some years ago was still guarded as a trade secret, but contains a good deal of practical information regarding the choice of suitable metal, the most efficient furnace for melting, and the most successful methods of annealing. The Siemens-Martin open-hearth process is referred to as the one best adapted to heavy work. The melting is effected by the influence of a hydro-oxygen flame, the hydrogen being derived from coal gas, and the oxygen from atmospheric air. The two gases before being combined are heated by the exhaust gases of the furnace, which, instead of being passed into the open through the stack, raise the temperature of a chamber composed of brick check work. The atmospheric air is introduced by means of a valve, and enters the furnace very hot. Among the most important features of these furnaces may be mentioned that they economize fuel, and that the iron is melted where it cannot be contaminated by the impurities of coal and coke. Since, however, the metal is worked at a much higher temperature than that of an air furnace, better bricks are required for the construction of the furnace, for the temperature of the bath rises from 3,500 to 4,000 F. For many castings the Siemens-Martin open-hearth furnace produces a metal, which for uniformity is quite unequalled ; after annealing, it is softer and tougher on account of the low carbon context, due to the fact that a larger amount of wrought scraps can be used in the make-up of a heat. To these advantages must be added that, compared with other furnaces, the economy in fuel amounts to about one-half when the same grade of coal is used, while the possibility of using coal or "slack" of poor quality is perhaps of even greater importance.

Manufacture of Steam Hammers.—In a paper read before the South Staffordshire Iron and Steel Institute, Mr. Harry B. Joy describes what he believes to be an economical iron and steel works plant for production of about 1,000 tons per month of merchant and guide-iron bars, and makes some remarks regarding steam hammers, which may interest manufacturers of these machines. The hammer used in the work described by him has no slides, he says, but the piston rod is unusally large in diameter, and the side thrusts are resisted by a very long stuffing box, but he cannot with safety speak favourably as to the merits of this kind of hammer. He suggests, in view of the fact that breakages of piston rods are so frequent, that users ought to go to the expense of providing special forged steel, planed sides, cast-steel tups, properly designed ball-end to their piston rod, and simple means by which to compensate for the wear at the bottom of the slides. Experts seem to agree with him that a steam hammer for shingling ought to have guides to resist the side thrusts, and not have to depend altogether upon a deep stuffing box. As regards, however, the use of forged steel for piston rods, there seems to be a divergence of opinion, and some manufacturers maintain that good wrought iron rods have a longer life. To avoid entirely the breakage of piston rods after long use is probably impossible, as these breakages are

in most cases due to the crystallisation of the metal from the repeated percussion shocks.

Demand for Steel Works in Spain.—According to official information sent to the Foreign Office by H.M. Consul at Cadiz, there seems to be a good opening for the establishment of steel works in that town, and any British capitalists or syndicate might secure a profitable investment of money by undertaking the erection of such works. Pig-iron of an excellent quality is obtainable from the neighbourhood of Malaga and other ports in the south of Spain, and Spanish coal, serviceable for the purpose, is easily procurable, while labour is plentiful and cheap, and the Spanish workmen are capable and steady.

RAILWAYS AND ROAD CONSTRUCTION.

Wear of Rails in Tunnels.—At a recent meeting of the Institution of Civil Engineers, Mr. Thomas Andrews read a paper on this subject, in which he stated that among the deteriorating influences peculiar to rails in tunnels must be counted the increased corrosion of the surface of the rails, due to the action of moist chemical vapours and the increased chemical action on them of the ballast—the latter on account of its porous nature absorbing chemical vapours. The author illustrated this by stating the results of his investigation of a rail that had lain in a tunnel seven years, on a straight piece of road, having a falling gradient of one in ninety, and had carried the main line traffic during this period without fracture. The tunnel was about 1,000 yards in length and was situated fairly near the sea-coast. Its direction was nearly north and south, a fact worth noticing since there were indications that magnetisation excited an influence tending to increase the corrosibility of steel in certain solutions. The rail, which originally had a weight of 87 lb. per yard, had lost weight at the rate of 2·8 lb. per yard, per annum, and on the face it had worn down $\frac{1}{8}$ of an inch. From the chemical analysis it appeared that sulphur was present in considerable excess, but otherwise the general composition of the steel was excellent. The physical condition was very good, the strength of the metal being normal and an elongation of 27 per cent. being obtainable without rupture. In consideration of these facts, the author recommended the employment of a heavier section for rails in tunnels and a wider bearing surface to compensate for the greater wear, and he suggested that such rails, as a general rule, should be allowed to remain in use only one half—or in some exceptional cases one third—of the time usually allowed for rails in the open.

Locomotive Trade.—It is pleasing to learn from competent sources that the Japanese have become firmly convinced from experience that British engines are the best, and that British exports of this article of manufacture are steadily increasing ever since American firms have raised their prices and are no longer in a position to accept orders for very short delivery. There seems to be no doubt that British manufacturers would obtain an excellent trade in Japan, if they could see their way to execute orders with sufficient speed to make the export possible within the limits permitted by the regulations binding Japanese importers; for these regulations forbid the latter to undertake contracts for more than a year a-head.

Extension of Euston Station.—It appears that Euston Station was considered large enough in 1845 for all time, but in 1869, and again in 1882, it was found necessary to make considerable extensions, at great expenditure, to accommodate the enormous increase of traffic which had taken place. This increase may be measured by the fact that whereas in 1868 the company had to deal with 1,500,000 passengers, and 2,500,000 in 1882, last year the number was over five millions. Again, whilst in 1868 there were only 81 regular trains in and out of Euston, in July, 1899, the number had increased to 226. These figures do not include milk trains, light engines, and so on. There had been a corresponding increase, too, in the parcels traffic in and out of the station. The proposal of the company is to double the number of lines into the station and to increase the greatly needed siding accommodation; to rebuild the hotel in the eastern corner of Euston Square, overlooking the gardens, which it is not proposed to touch: to pull down the present offices and bring them forward, and to utilize the intermediate space for the enlargement of the station. For this purpose they will have to take down houses in Mornington Crescent, Euston Street, Melton Street, and Seymour Street, and close Drummond Street. The cost of the scheme is estimated at £1,900,000.

Railway Trucks treated with Oil.—About three years ago a method of treating road beds of railways with non-combustible oil for laying dust was adopted on one of the New Jersey divisions of the Pennsylvania Railroad, and proved so successful that it has been since introduced by a number of companies in the eastern States. It has been shown that when a track ballasted with gravel or cinder is well sprinkled with oil the dust is practically got rid of, while the oil possesses the additional advantages of destroying weeds, preserving the ties and rendering the track waterproof. The system, however, seems less applicable where fine sand ballasting is used, for, unless the

sprinkling is very heavy, there is danger of a top layer of the sand caking and of flying dust laden with oil. Nevertheless on one of the New Jersey roads the use of 2,500 gallons of oil per mile of track has effectually laid the fine sand. The oil used is of very low combustible grade, so that there is little or no danger from fire.

REFRIGERATION.

Wolverhampton Plant.—Mr. Jno. Bradley, the borough surveyor of Wolverhampton, has reported to the Markets Committee of the Town Council, as to the cold storage capacity required, and the cost of the plant necessary. He recommends that a store of 22,500 cubic feet capacity be first taken in hand and that when this is done sufficient land will then be left for 50,000 cubic feet more. He recommends ammonia compression machines and the cold air current system of distribution. The cost of the stores and ice-making factory is estimated at £5,700, and the machine plant at £3,750. The Markets Committee recommends that "conditional upon Parliamentary sanction being obtained" for providing stores, plant, &c., the finance committee be authorised to apply to the Local Government Board for their consent to the loan of £9,450.

The North British and Cold Storage and Ice Company's premises at Leith.—The total cost amounts to £30,000. The building is 142 ft. long, 90 ft. broad, and 70 ft. high. There are eight cold chambers each of a capacity of 9,000 to 14,000 cubic feet, the temperatures maintained in them ranging between 15° and 38° Fah. The De La Vergne system has been adopted, and the machinery supplied by Messrs. L. Stern and Co. A 40-ton machine makes 30 tons of ice a day from the town water.

Refrigerator Ships at Capetown. — The United States Consul-General at Capetown reports to his Government as to "lack of ships with cold storage space" preventing them capturing "any of this great trade." "The recent Act passed provides for the issue of loans for cold storage plants to be built by anyone. The trade in chilled meat is in the hands of a monopoly. I wish to call the attention of our cattle and sheep raisers to the fact that while the United States has no refrigerator ships, plenty of ships can be chartered to bring good slaughter-stock here."

New Installations.—Messrs. J. and E. Hall have completed the refrigerating installation for the *Suffolk*, *Norfolk* and *Sussex*, which will be the largest ever fitted on board ship. Each of them can carry 130,000 carcases of mutton. The same firm will fit the four new ships now in course of construction for the P. & O. Company.

Earnings of Refrigerator Ships. — Mr. Campbell, the manager at Montreal of Messrs. Elder, Dempster and Co., has been explaining to the Bristol provision merchants that the refrigerating chambers on board their steamers have not paid them very well. They only carried butter between June and October, and during the rest of the year they had nothing else to put in the chambers. The fitting of the four steamers cost £25,000, and the cost of working was £1,500. The removal of the refrigerator had been under consideration. The payment for carriage of butter was 10s. per ton, and they received last year £2,000 in all.

AGRICULTURAL MACHINERY.

Agricultural Machinery in South Africa.—When the present troubles are ended and the "Pax Britannica" is thoroughly established over the whole of South Africa, agriculture will undoubtedly receive a great impetus under the new and more progressive *régime* of British government. Every indication at present goes to show that a large influx of British and Colonial settlers will take place, of whom a great proportion will start as farmers, on the fertile lands of the Orange Free State, Cape Colony and Rhodesia. Up till now the Americans and Germans have done at least three fourths of the agricultural implement business in this part of the world. Since the war began practically no business has been done in implements by any one, and it would seem that the present is a splendid opportunity for the British implement maker to regain possession of the South African market. We originally lost it through the usual faults, namely, want of push and adaptability. The ploughs made by British firms have always been too heavy and solid. The greater part of the Orange Free State, Rhodesia and the Western division of Cape Colony, is covered with a light sandy soil which requires a light plough to work it. Why cannot we turn out a light plough at a moderate price which will be in every respect as good as the American and German articles? The trade in ploughs in South Africa has never been of the "cheap and nasty" order. Farmers there are quite prepared to pay a reasonable price, provided they get an implement suited to the soil they have to work. Up till now the firms who would supply them were practically all Germans and Americans. It is to be hoped that our own Agricultural Engineers will really make a strong effort to secure the South African market again, but they must study their customers' wants more. An opportunity like the present may never occur again.

An Opening in China.—In a recent report from the United States Consul at Chin Kiang, some interesting and valuable hints are given

regarding the conditions of Agriculture in that part of China and the openings there are for implement makers. The report describes the farms as ranging from half an acre to five acres ; hence reapers, mowers, threshing machines, and steam ploughs are not wanted. The plough used on wheat or barley farms is made of a crooked stick with a steel point fastened to it, and is pulled by a water buffalo, a kind of half-breed between Texan cattle and the Western buffalo. The grain is cut by men and women with a blade inserted in a short handle at an angle of 45 degs., and is threshed by the buffalo tramping the grain out of the ear. Then, the wheat or barley winnowed, is put into bags, and pounded for use as required. The report suggests that a good market might be found for hoes, rakes, shovels, scythes, hand threshers, fanning mills, and cheap apparatus for grinding.

MISCELLANEOUS.

Trade with Russia.—The British commercial agent in Russia has sent to the Foreign Office a translation of an extract from the *Torgovo-Promishlennaia Gazeta (Industrial and Commercial Gazette)*, the official organ of the Department of Trade and Manufactures of the Russian Ministry of Finance which reads as follows :—"Notices and announcements from the Department of Trade and Manufactures. The undermentioned American firms, engaged in the raw material trade, have expressed a desire to enter into direct communication with Russian houses and firms." (Here follows a list of names and addresses.) There can be no doubt that such a reference directory in an official Russian organ must be of considerable value to the firms registered, and British firms ought to secure a similar notice by communicating with the Imperial Russian Financial Agency, 107, Cromwell-road, S.W., or by addressing themselves directly to the Department of Trade and Manufactures of the Ministry of Finance at St. Petersburg. The British Commercial Agent states that no fees are payable, whether the application for a notice be granted or not.

Messrs. Meldrum Bros., Ltd., of Manchester and London, &c., have recently received a number of important contracts for their well-known Refuse Destructors, among the latest orders placed with them being those for Heywood (to be erected and the power used at the Sewage Works), and Barrow-in-Furness, where the destructor and power plant will be used in connection with the Electric Lighting of the town.

Typewriting Machines.—According to the New York *Journal of Commerce*, of April 19th, the Spanish Government has authorized the use of typewriting machines in all Government office work. This will, no doubt, cause a great demand for such machines in the Peninsula, not only in official bureaus but also in private offices.

Imports to Chicago.—According to H. M. Consul in Chicago, good Sheffield cutlery put up in cases for wedding presents, etc., and British electro-ware in services, canteens, or households would find a ready sale in that city. He advises British manufacturers to write to the Consulate in order to find out whether their goods would find a market or not, and states that the Consulate will render every assistance. There are many now, he adds, who put themselves into communication with the Consular office, but the number, after all, is small compared with the advantages to be obtained.

Exports to Austria Hungary.—The Chamber of Commerce in Prague, Reichenberg, Pilsen and Budweis have consented, at the request of H.M. Consul at Prague, to receive and place in their export bureaus for public information any price lists and catalogues from British firms and manufacturers desiring to extend their trade with Austria-Hungary. Such business announcements, however, ought to be in German if possible, as the number of Austrian merchants that read English is comparatively limited. It may be well to remind our readers that the principal imports from Great Britain into Austria are iron, leather, machinery, cotton, jute, rice, indigo, spices, linseed, gums, etc., and also coffee and cocoa, while exports to England from that country are sugar, leather goods, eggs and glass. H.M. Consul at Prague states that there is an increasing demand for English furniture, groceries, hosiery, hats, stoneware and drapery, such as linings, curtains, etc.

British Exports to Poland.—The first requisite for British business men who wish to obtain a share of the large and profitable trade of Russia is to study the country and its ways of doing business, and try to accommodate themselves to its wants. Otherwise Germany will soon have usurped the whole of the Russian markets. The use of the Russian language and Russian money, weights and measures, has been too often insisted on to need repetition. Surely it is the part of the seller to accommodate himself to the buyer. Foreign firms usually quote a price in roubles at the town where the order is given ; British firms almost invariably do so in £ s. d. in the United Kingdom. The articles in which the strongest competition is to be expected are cognac, belting, lubricants, wines and technical articles.

In this section is presented every month a concise precis of the contents of the leading organs of the technical press and of the proceedings of learned societies throughout Great Britain, the Continent, and America, and also, in a summarized form, the subject matter of the more important articles appearing therein.

This systematic record should prove of the greatest value to those of our readers interested in one or more specific sections of technology, trade or economics, or to those who have insufficient leisure to peruse the large number of publications now appearing.

The following is an Index to the abbreviations used throughout the section. It gives an alphabetically-arranged list of the publications regularly reviewed, together with the place of publication and price. Should any of our readers desire further information we shall be happy to supply it.

Advertisers' Review	London	1d.	*Ad. Rev.*
American Engineer	New York	20c.	*Am. Engr.*
American Machinery	New York	10c.	*Am. Machy.*
American Machinist	New York	6c.	*Am. Mach.*
American Manufacturer & Iron World	Pittsburg	$4 yr.	*Am. Mftr. and Ir. Wld.*
American Shipbuilder	New York	10c.	*Am. Shipbldr*
Annales des Ponts et Chaussées	Paris		*Ann. des Pts. et Chauss.*
Architect	London		*Archt.*
Architectural Record	New York		*Arch. Rcd.*
Architectural Review	Boston U.S.A.	1s.	*Arch. Rev.*
Arms & Explosives	London	6d.	*Arms and Exp.*
Australian Mining Standard	Sydney	6d.	*Aust. Min. Stand.*
Australian Trading World	London	2d.	*Aust. Trdg Wld.*
Automotor and Horseless Vehicle Journal	London	6d.	*Autom. and Horsel. Veh. Journ.*
Berg und Hüttenmannische Zeitung	Berlin		*Berg Hütteum. Ztg.*
Board of Trade Journal	London		*Board of Tr. Journ.*
Book & News Trade Gazette	London	1d.	*Bk. and Nws. Trd. Gaz.*
British Architect ...	London	4d.	*Brit. Archt.*
British & Colonial Druggist	London	10s. yr.	*Br. and Col. Drgst.*
British & Colonial Printer	London	2d.	*Bri. and Col. Prtr.*
British Printer ...	Leicester	1s.	*Br. Prtr.*
Builder	London	4d.	*Bldr.*
Builders' Journal	London	1d.	*Bldr's Journ.*
Bulletin de la Société d'Encouragement	Paris		*Bull. d. l. Soc. d'Encour.*
Canadian Architect	Toronto		*Canad. Archt.*
Canadian Electrical News	Toronto		*Canad. Elec. News.*
Canadian Engineer	Montreal		*Canad. Engr.*
Canadian Manufacturer	Toronto	8s. yr.	*Can. Mftr.*
Canadian Mining Review	Ottawa		*Canad. Min. Rev.*
Carriage Builders' Journal	London	10s. yr.	*Carr. Bldrs' Journ.*
Chamber of Commerce Journal	London	1s.	*Chamb. of Com. Journ.*
Chemical Trades Journal	Manchester	4d.	*Chem. Trds. Journ.*
Coach Builders' Art Journal	London	25s. yr.	*Coachbldrs'. Art Journ.*
Cold Storage ...	London	6d.	*Cold Storage*
Colliery Guardian	London	6d.	*Coll. Guard.*
Commerce	London	6d.	*Comm.*
Commercial Intelligence	London	1d.	*Com. Int.*
Comptes Rendus de l'Acad. des Sciences	Paris		*Compt. Rend.*
Compte Rendu de la Société des Ingénieurs Civils	Paris		*Compt. Rend. des Ing. Civ.*
Contract Journal	London	6d.	*Contr. Journ.*
Deutsche Techniker Zeitung	Berlin	9 *mk.* 25 *pf.* yr.	*Deutsch. Techn. Ztg.*
Dingler's Polytechnisches Journal	Stuttgart		*Dingler's Polyt. Journ.*
Diplomatic & Consular Reports	London & Washington		*Dipl. and Cons. Rpts.*
Echo des Mines ...	Paris & Brussels	40 *fr.* yr.	*Ech. d. Mines*
Eclairage Electrique	Paris		*Ecl. Elect.*
Electrical Engineer	London	3d.	*Elec. Engr.*
Electrical Engineering	Chicago		*Elec. Engrg.*
Electrical Review ...	London	4d.	*Elec. Rev.*, London
Electrical Review ...	New York	10c.	*Elec. Rev.*, New York
Electrical World ...	New York	10c.	*Elec. Wld.*
Electrician	London	6d.	*Electn.*
Electricien	Paris		*Electn.*, Paris
Electricity	London	1d.	*Electy.*, London
Electricity	New York	10c.	*Electy*, New York
Elektrochemische Zeitschrift	Berlin		*Elektrochem. Ztschrft.*
Elektrotechniker	Vienna	12 *mk.*	*Electrotechniker* yr.
Elektrotechnische Zeitschrift	Berlin		*Elektrotech. Ztschrft.*
Elettricita	Milan		*Elettricita*
Engineer	London	6d.	*Engr.*
Engineer	Cleveland U.S.A.	5c.	*Engr.*, Cleveland
Engineering ...	London	6d.	*Engrg.*
Engineering and Mining Journal	New York	15c.	*Engrg. and Min. Jour.*
Engineering Magazine	New York & London	1s.	*Engrg. Mag.*
Engineering News	New York	15c.	*Engrg. News.*
Engineering Record	New York	12c.	*Engrg. Rcd.*
English & Amer. Gazette	Paris	20c.	*Engl. and Am. Gaz.*
English Mechanic	London & New York	2d.	*Engl. Mech.*
Gas Engineers' Magazine	Birmingham	6d.	*Gas Engrs. Mag.*
Gas World	London	6d.	*Gas Wld.*
Gaz, Le	Paris	1 *fr.*	*Gaz*
Génie Civil	Paris	1 *fr.*	*Gén. Civ.*
Gesundheits-Ingenieur	Munchen		*Ges. Ing.*
Glaser's Ann. f. Gewerbe und Bauwesen	Berlin		*Glaser's Ann.*
Hardware, Metals & Machinery	London	5s. yr.	*Hrdw., Mets. and Machy.*
Hardware Trades Journal	London	6d.	*Hrdw., Trds Journ.*
Heating & Ventilating	New York		*Heating and Venting.*
Hosiery Trade Journal	Leicester	2s. 6d.	*Hosiery Tr. Jr.*

Ice & Cold Storage	London	6d.	*Ice and Cld. Storage.*
Illustrated Official Journal of Patents	London	6d.	*Ill. Off. Journ. of Pat.*
Indian & Eastern Engineer	Calcutta	R1.	*Ind. and East. Engr.*
Indian Engineering	Calcutta		*Ind. Engrg.*
Industrie Electro Chimique	Paris	60c.	*Ind. Elec. Chim.*
Industries & Iron...	London	4d.	*Ind. and Ir.*
Ingenorum	Copenhagen	2kr. 50ore.	*Ingm.*
Invention	London	1d.	*Inv.*
Irish Textile Journal	Belfast	11s. 6d. yr.	
Iron Age	New York		*Ir. Age.*
Iron and Coal Trades Review	London	6d.	*Ir. and Coal Trds. Review*
Iron and Steel Trades Journal	London	3d.	*Ir. and Steel Trds. Journ.*
Ironmonger ...	London	6d.	*Irnmgr.*
Journal of the Association of Engineering Societies	Philadelphia	20c.	*Jr. Ass. Eng. Socs.*
Journal of the Chemical Society	London	30s.	*Jrn. Chem. Soc.*
Journal of Commerce	Melbourne	15s.	*Journ. of Comm.*
Journal of Electricity	San Francisco		*Jour. of Elec.*
Journal of Electricity Power and Gas	San Francisco	10c.	*Journ. of Electr. Power and Gas*
Journal of Gas Lighting	London	6d.	*Journ. of Gas Lghting.*
Journal Inst. Elec. Engrs.			
Journal of Royal Inst. of British Architects	London	1s.	*Journ. of Roy. Inst. of Br. Archts.*
Journal of State Medicine	London	2s.	*Journ. of State Med.*
Journal of the Society of Arts	London	6d.	*Journ. of Soc. of Arts*
Knowledge	London	6d.	*Knowl.*
Laundry Journal ...	London	1d.	*Ldry. Journ.*
Laundry Record ...	London	4d.	*Ldry. Rec.*
Lightning	London	2d.	*Lghtng.*
Light Railway and Tramway Journal	London	1s.	*Lt.Ry. & Trmy.Jr.*
Literary World ...	London	1d.	*Lit. Wrld.*
Locomotive Engineering	New York	20c.	*Locom. Engrg.*
Locomotive Magazine	London	2s. 6d. yr.	*Loc. Mag.*
Machinery	London	8s. 6d.	*Machinery,* London
Machinery	New York		*Machinery,* New York.
Machinery Market	London	6d.	*Mach. Mark.*
Manufacturer ...	Philadelphia	$5 yr.	*Mftrr.*
Marine Engineer ...	London	6d.	*Mar. Engr.*
Marine Engineering	New York	6d.	*Mar. Engrg.*
Mechanical Engineer	Manchester	6d.	*Mech. Engr.*
Mechanical Progress	M'chr	3d.	*Mech. Prog.*
Mechanical World	London	1d.	*Mech. Wrld.*
Medical Record ...	New York	10c.	*Med. Recd.*
Metallurgie ...	Paris	22fr.	*Metall.*
Miller	London	5d.	*Miller*
Mines and Minerals	Denver	20c.	*Mns. & Mnrls.*
Mining Journal ...	London	6d.	*Min. Journ.*
Mining World ...	London	6d.	*Ming. Wld.*
Mitt. aus d. Kgl. Tech. Versuchsanst	Berlin		*Mitt. a. d. Kgl. Tech. Versuchsanst,* Berlin.
Modern Machinery	Chicago	$1	*Mod. Machy.*
Mois Scientifique	Paris	$1.50	*Mois. Scient.*
Motor Car Journal	London	1d.	*Motor Cr. Jr.*
National Laundry Journal	Chicago	15c.	*Nat. Ldry. Journ.*
Nature	London	6d.	*Nature*
Nature	Paris		*Nature,* Paris
Nautical Gazette ...	New York	10c.	*Naut. Gaz.*
North British Agriculturist	Edinburgh	1d.	*N. B. Agrilt.*
Oest. Monatsschr f. d. Oeff. Baudienst	Vienna		*Oest. Monatsschr. f. d. Oeff. Baudienst*
Oest. Zeitschr. f. Bergund Hüttenwesen	Vienna		*Oest. Zeitschr. f. Berg u. Hüttenwesen.*
Paper & Pulp ...	London	6d.	*Pap. and Plp.*
Power...	New York	10c.	*Power*
Practical Engineer	London	2d.	*Pract. Engr.*
Proceedings, Am. Soc. of Civil Engineers	New York	$6	*Proced. Am. Soc. Civ. Engrs.*
Proceedings of the Engineers' Club of Philadelphia	Philadelphia	$2	*Proced. Engrs. Club*
Public Health Engineer	London	3d.	*Pub. Hlth. Engr.*
Railroad Gazette ...	New York	$6.08	*Rlrd. Gaz.*
Railway Age... ...	Chicago	10c.	*Ry. Age*
Railway Engineer	London	1s.	*Rail. Engr.*
Railway and Engineering Review	Chicago	$5	*Rail and Engng. Rev.*
Railway Magazine	London	6d.	*Rail. Mag.*
Railway Master Mechanic	Chicago	$1.50	*Railw. Mast. Mech.*
Railway News ...	London	6d.	*Rail. News*
Railway Official Gazette	London	1d.	*Rail. Off. Gaz.*
Railway Record ...	London	6d.	*Rail. Rcd.*
Railway Supplies Journal	London	6d.	*Ry. Sup. Jr.*
Revista Minera ...	Madrid	25fr.	*Rev. Min.*
Revue Technique ...	Paris	1fr.	*Rev. Tech.*
Revue de Chimie Industrielle	Paris	15fr.	*Rev. d. Chim. Ind.*
School of Mines Quarterly	New York	50c.	*Sch. Mines Qlly.*
Science Abstracts	London & New York	2s.	*Science Abstr.*
Scientific American	New York	$4 yr.	*Sci. Am.*
Scientific American Supplement	New York	$5 yr.	*Sci. Am. Suppl.*
Shipping World ...	London	6d.	*Shpng. Wrld.*
Shoe Manufacturers Monthly	London	2s.	*Shoe Mfrs. Mthly.*
South Africa ...	London	6d.	*South Afr.*
Stahl und Eisen ...	Dusseldorf	24mk. yr.	*Stahl u. Eisen*
Steamship	Leith	6d.	*Steamsh.*
Stevens' Institute Indicator	New York	50c.	*Stevens' Inst. Ind.*
Stone	New York		*Stone*
Street Railway International Journal	New York	50c.	*St. Ry. Inter. Jr.*
Surveyor	London	6d.	*Survr.*
Syren	London	3d.	*Syr.*
Technology Quarterly	Boston	75c.	*Tech. Qlly.*
Textile Industries	Bradford	10s. yr.	*Text. Ind.*
Textile Mercury ...	Manchester	1d.	*Text. Merc.*
Textile Recorder ...	Manchester	12s. yr.	*Text. Rcdr.*
Textile-Zeitung ...	Berlin	16 mk. yr	*Text. Ztg.*
Trade & Finance ...	London	1d.	*Trde. and Fin.*
Trade & Industry...	Manchester & London	6d.	*Trde. and Ind.*
Trade Journals Review	London	6d.	*Trde. Journ. Rev.*
Tramway & Railway World	London	1s. 3d.	*Tramw. and Railw. Wld.*
Transactions of the American Society of Mechanical Engineers	Cincinatti		*Trs.Am. Soc. M.E.*
Transactions of the Inst. of Naval Architects	London		*Trs. Inst. Nav. Arch.*
Trans. Inst. Engrs. & Shipbuilders	Glasgow		
Transactions of the N. E. Coast Institution of Engineers and Shipbuilding	Newcastle		*Trs. N. E. Inst. Engrs. and Shpbldrs.*
Trans. Soc. Engrs.			
United Service Magazine	London	2s.	*Un. Ser. Mag.*
Western Electrician	Chicago	10c.	*West. Electn.*
World's Pulp and Paper Industry	London	6d.	*Wld's Pulp and Ppr. Ind.*
Zeitschr. d. Oest. Ing. u. Arch. Vdr.	Vienna	30 fr. yr.	*Ztschrft. d. Oest. Ing. u.. Arch. Ver.*
Zeitschr d. Ver. Deutscher Ingen.	Berlin		*Ztschrft. d. Ver. Deutsch. Ing.*
Zeitschrift für Halle a. S. Elektrochemie		16 mk. yr.	*Ztschrft. f. Elektrochem.*
Zeitschrift für Halle a. S. Elektrotechnik			*Ztschrft. Elektrotech.*

ARCHITECTURE AND BUILDING.

1. Construction and Design.

Architecture.—*Architectural Acoustics. Reverberation. The Absorbing Power of an Audience and other Data.* By Prof. Wallace C. Sabine, Harvard University. Abstract of a paper in which the author defines all the data necessary for calculating the reverberation in any auditorium from its plans and specifications. 4½ cols.—*Engng. Rcd.*, May 19th, 1900.

Building.—*Some Cities of Modern Italy.—Bologna.* The author speaks with high appreciation of the artistic features of the modern improvements in Bologna, which show that the gloomy anticipations so frequently expressed in former years regarding the effect of modern innovations were by no means justified. 4 cols.—*Builder*, May 19th, 1900.

Chimneys.—*The Custodis Chimney.* Description of a type of chimneys designed by Mr. Alfred Custodis, of Düsseldorf on the Rhine, which is extensively used in Continental Europe, as for instance, in the works of Krupp and in the factories of the Trans-Siberian railway, and which has recently been introduced also into the United States. (Ill.) 1 col.—*Power*, May, 1900.

Construction.—*Breakdown of the Foot-Bridge leading to the "Celestial Globe" in the Paris Exposition.* The author of the article discusses the causes which brought about a deplorable accident in the Paris Exposition grounds by which, on April 20th, nine persons were killed and ten others were more or less severely injured. He comes to the conclusion that these causes were chiefly two: First, the too hasty removal of the supports of a beton composed perhaps of inferior materials, and secondly, the giving way of the soil owing to excavations in great proximity to the structure; he declines, however, to express a definite opinion until the results of the investigation have been published which is proceeding at this moment. (Ill.) ¾ col.—*Génie Civil*, May 5th, 1900.

English Halls.—*Some Old Derbyshire Houses.* Interesting article describing some old English mansions in the country sourrounding Cartledge Hall, near Sheffield, showing a great variety of styles, included in the term English Renaissance and characterised by an honest use of local material and an avoidance of fussiness in details. (Ill.) 9 cols.—*Bldrs. Journ.*, May 9th, 1900.

English Mansions.—*Kingston House.* The article gives a short sketch of the history of Kingston House, in Bradford-on-Avon, which is reproduced in the English Pavilion of the Paris Exposition and is said to have been built for Sir Walter Hungerford, about 1570, by John of Padua, and for some time was in possession of the Dukes of Kingston from whom its present name is derived. 1 col.—*Brit. Arch.*, May 11th, 1900.

Hospital Equipment.—*The Requirements of Modern Hospitals.* Summary of a lecture delivered before the Section of Hygienic Engineering, Vienna, by Mr. Franz Berger, Chief Engineer. The author describes very fully the chief improvements in hospital and ambulance equipment. (Ill.) To be continued. 15 cols.—*Ztschrft d. Oest. Ing. u. Arch. Ver.*, May 11th, 1900.

Hospitals.—*The Requirements of Modern Hospitals.* Abstract of a lecture delivered at the Section of Hygienic Engineering of the Austrian Society of Engineers and Architects by Mr. Franz Berger, Chief Engineer, &c. Conclusion. (Ill.) 12 cols.—*Ztschrft. d. Oest. Ing. u. Arch. Ver.*, May 18th, 1900.

Metal Work.—*Art Metal Work.* By Nelson Dawson. Report of a lecture on metal work delivered on May 12th, before the Society of Arts, in which the author very justly points out that real art, even when found in articles of daily use, is due to inspiration, and that modern metal work does, in this regard, not compare favourably with the work of the past. 18½ cols.—*Journ. Soc. Arts*, May 18th, 1900.

Office Building.—*Tall Office Buildings. Model for the World's Fair.* Description of a very interesting model constructed from the plans of Mr. H. C. Hinchcliff, of New York, by Mr. Corydon T. Purdy for the Western Society of Civil Engineers in the United States. The model, for which a sum of £5000 has been paid, is an exact reproduction, on the scale of ½ inch per foot, of the Broadway Chambers, New York. The elevator system, without which such tall buildings are impossible, is also shown by four beautifully constructed models of the Otis elevator. 1 col.—*Sci. Am.*, May 12th, 1900.

2. Heating, Ventilation and Sanitation.

Heating, Lighting, and Refrigeration.—*Hot Water Heating from a Central Station.* Abstract of a paper presented by Mr. H. T. Yaryan, M. Am. Soc. M. E., to the Cincinnati meeting of the American Society of Mechanical Engineers, and describing a plant erected by the Toledo Heating and Lighting Co., at Toledo, Ohio, U.S.A., in which the cost is covered by the receipts for heating, and electricity is treated as a by-product, yielding an equal amount of income without extra expenditure. During the present year a refrigeration plant is to be supplied by the same power plant. 3 cols.—*Engng. News.*, May 17th, 1900.

—— *Central Hot-Water Heating Plants.* Abstract of a paper by Mr. H. P. Yaryan, of Toledo, Ohio, describing the hot-water heating and lighting of the Toledo Heating and Lighting Co., at Toledo, Ohio, U.S.A. (Ill.). 2¾ cols.—*Engng. Rcd.*, May 19th, 1900.

—— *Presidential Address by Mr. S. M. Nesbit, M.I.M.E.* The author, in his address to the Institution of Heating and Ventilating Engineers, on May 1st, dwelt especially upon some apparent defects of the customary heating and ventilating methods in the organizations of the trade, the education of heating and ventilating engineers, etc. 2¾ cols.—*Builder*, May 5th, 1900.

—— *"Olymp," a novel Ventilating, Heating, and Refrigerating Plant.* Description of a plant devised and patented by M. Michael Kugler, Engineer and Inspector of the Royal Hungarian Railways at Buda-Pesth. 1¼ col.—*Ztschrft d. Oest. Ing. u. Arch. Ver.*, May 25th, 1900.

—— *Ventilation and Heating, Appellate Court House, New York.* Description of a very interesting and complete plant for warming and ventilating in a public building opened in New York city during the first week of January. 4½ cols.—*Engng. Rcd.*, May 12th, 1900.

3. Plumbing and Gasfitting.

Gasfittings.—*Cheaper Mantles.* Comments on the economy derived from using incandescent mantles. With the improved mantles now obtainable in England the value of 16 c.p. gas is raised to something over 20 c.p., an increase in efficiency and therefore in economy of over 25 per cent. In Germany, where mantles can be purchased for about one third of the price paid in England, 80 per cent of the lighting is by the incandescent system, while in Great Britain it amounts to only 20 per cent. The author, therefore, declares that the Welsbach Company, by its announced reduction of the price of mantles, will not lose, but rather gain, in consequence of the certain increase of customers. ¾ col.—*Ironmonger*, May 26th, 1900.

—— *Incandescent Mantle and Its Use.* By Prof. Vivian B. Lewes—III. This is the Cantor Lecture delivered before the Society of Arts on the 21st of May, 1900. The author points out that the history of the incandescent mantle is not devoid of attempts to introduce forms suitable for flames other than those given by the Bunsen burning from a circular tube, and describes De Marc's mantle for flat flames, the De Lery Burner and its Baby Mantles; he then discusses the attempts to strengthen the ordinary burner; the early forms of burner, regulation of the air and gas supplies, how the non-luminous flame is produced, the varying effects of diluents, the chemical changes in a Bunsen flame, how the best results are obtained, the carbonization of the mantle, the chimney, improvements in the burners and the illuminating power. He concludes with: "A Word to Manufacturers." 9 cols.—*Gas Wrld.*, May 26th, 1900.

4. Miscellaneous.

Exhibition Buildings.—*The Royal Pavilion, Paris Exhibition.* Description of the Royal Pavilion in the Rue des Nations on the Quai D'Orsay, Paris; the north side of which is an adaptation of the south facade of the "Hall" at Bradford-on-Avon; the architect is Mr. Edwin Lutyens, and a large number of English firms have contributed to the decorations, etc. 1¾ col.—*Bldr.*, May 26th, 1900.

CIVIL ENGINEERING.

1. Bridges.

Bridges.—*Viaduct Approaches for the New East River Bridges at New York City.* The article deals with some of the typical structural details of the viaduct approaches for the New East River Bridge, now under construction at New York City. (Ill.) 5 cols.—*Engng. News*, May 10th, 1900.

—— *Erection of Towers, New East River Bridge.* Description of the steel towers weighing 300 tons each and rising to a total height of 332 ft. 8½ inches above high-water level. (Ill.) 6½ cols.—*Engng. Rcd.*, May 5th, 1900.

—— *The Third East River Bridges.* Besides the New East River Bridge from New York to Brooklyn, which has for several years been under construction, the plans have been finished for a Third East River Bridge, to be located between the famous old Brooklyn Bridge and the new bridge. The article gives the main data of this bridge and an illustration showing the general appearance of the structure. 1 col.—*Engng. Rcd.*, May 12th, 1900.

—— *Special Bridge and Viaduct Construction in Western Pennsylvania.—II.* The present instalment deals with a large amount of complicated construction at Fort Perry, Pa., where the Union Railroad crosses the Monongahela River, over a 3,400 ton six-span bridge of a length of 1,340 ft. (Ill.) 3¾ cols.—*Engng. Rcd.*, May 19th, 1900.

—— *Novel Type of Rigid Suspension Bridge.* The author explains the causes which have effected the abandonment of the flexible suspension bridges which some time ago were so popular on account of their great elegance and ingeniousness of construction, and proposes a novel type entirely free from the drawbacks of the older style. 5 cols.—*Génie Civil.*, May 5th, 1900.

—— *The New "Franzensbrücke" across the Danube Canal in Vienna.* By Chief Engineer Franz Pfeuffer, Vienna. Full description of a very interesting type of bridge building. (Ill.) 12 cols.—*Ztschrft. d. Oest. Ing. u Arch. Ver.*, May 4th, 1900.

2. Canals, Rivers and Harbours.

Canals.—*The Hotopp Syphon Lock on the Elbe Trave Canal.* In the great days of the Hausa, the Stecknitz Canal was constructed from the Elbe to the Trave, on which Lübeck is situated. Now that Lübeck is rising once more to importance, the old Stecknitz Canal, opened in 1398, has been closed after almost 500 years of service, and is to be revived in the modern Elbe-Trave Canal, which is approaching completion. This new canal, following essentially the old route, has a length of 67 kilometres (41·6 miles), a bottom width of at least 22 metres (72 ft.), and a minimum depth of 2 m. (6 ft. 7 in.). It is not a big canal, therefore, but the manner of working the locks is novel and very interesting and is described from the facts given by Prof. Hans Arnold in the *Ztschrft. d. Ver. Deutsch. Ing.* (Ill.). 4 cols.—*Engng.*, May 4th, 1900.

—— *New Water-ways Projected in Germany.* The article deals with a number of projects referring to the construction of canals in Germany, and, omitting the much discussed "Midland Canal" and the "Berlin-Stettin" Canal, discusses the Teltow-Canals, south of Berlin, which is to have a length of 37 k.m.; the Elbe-Kiel Canal, 75 k.m. in length, a canal from Wiemar to Lake Schwerin, the Hunte-Ems-Canal and various minor water ways, sooner or later to be constructed. 1½ col.—*Ztschrft. d. Oest. Ing. u Arch. Ver.*, May 25th, 1900.

—— *A Proposed Waterway from Lake Michigan to the Mississippi River.* The article deals with the project of extending the drainage canal destined to carry the sewage of Chicago westward by the Desplaines and Illinois rivers, now completed to the Mississippi river, thus establishing a navigable course between the Great Lakes and the Gulf of Mexico. (Ill.) 2¾ col.—*Engng. News*, May 3rd, 1900.

Dams.—*Irrigation Works on the Nile.* The article deals with the Assouan Reservoir and Dam and gives a detailed account of the progress made in connection with these great enterprises, of which the preliminary works in connection with the construction of the Assouan Dam were commenced in April, 1898. (Ill.) 3½ cols.—*Engr.*, May 11th, 1900.

Locks.—*The Lift-Lock at Henrichenburg.* By M. W. Schulz, Engineer Cüstrin. Description of this famous engineering work, which is the first lift-loch constructed in Germany and the largest in existence anywhere; there are three smaller lochs, one at Anderton, England, one at La Soubiere, Belgium, and one at Le Fontisnettes, France. 4¼ cols.—*Electro-Techniker*, May 15th, 1900.

3. Irrigation.

Irrigation Works on the Nile.—*The Assiout Barrage.* Description of the work done on the Assiout barrage up to a recent date. The author points out that the work done at this place during the months of September, October and November last year, was chiefly the collection of materials and the putting of machinery into working order. At the beginning of January, this year, 40,000 cubic metres of excavation had been removed from the site of work, and a portion of the site was down to floor level; masonry work was proceeding on the loch-walls and on the piers, and 1,300 cubic metres had been rebuilt since the restarting of the work on December 26th. By the beginning of February a great advance had been made in every direction. The total excavation during the season was 152,000 cubic metres. 1¼ col.—*Engr.*, May 25th, 1900.

4. Miscellaneous.

Dam Breakdown.—*Failure of the Austin Dam.* By Judge Wm. von Rosenberg, jr., Austin. The author was an engineer before he joined the legal profession and his evidence is considered to be particularly important. He declares that in his mind there is no doubt that the break in the Austin dam was due to undermining and that a serious erosion existed beneath the toe of the dam. 1½ col.—*Engrg. Rcd.*, May 19th, 1900.

Nicaragua Canal.—*The Chances of the Nicaragua Canal.* Editorial, pointing out that there is need for a campaign of education to prepare the American mind for the adoption of a policy of wisdom in regard to the canal problem; showing that it is safest for the United States and the best for her, as well as for the rest of the world, to secure for the canal perfect neutrality under the guarantee of all the maritime nations of the world, as a waterway which shall be open at all times, in war as in peace, to ships of every kind under every flag. 1¼ col.—*Engr.*, May 25th, 1900.

Roads and Highways.—*The Management of Roads and Highways.* By Mr. George Joseph Bell. Abstract of an address delivered by the author as President of the County Surveyor's Society, under the title of "The Suggested Future Management of all Roads by County Councils, and the Amendment and Codification of all existing Highway and Bridge Acts." 1¼ col.—*Engng.*, May 25th, 1900.

ELECTRICAL ENGINEERING.

1. Electro-Chemistry.

Electro-Chemistry.—*Electrolytic Galvanization.* Digest of a pamphlet entitled: "Galvanization or Electro-chemical Zinc-plating by a Cold Method" by M. L. Quivy, in which the author describes the working of a small plant for the purpose, comprising a dynamo of the Gramme type, yielding 900 ampères, a distributing board and four baths for zinc-plating. 3 cols.—*L'Industrie Electro-Chimique*, March, 1900.

—— *Experiments with Alkaline Chlorides.* By Mr. E. Winteler. (Conclusion). The author gives a complete description of a number of very interesting electro-chemical experiments. 13¾ cols.—*L'Industrie Electro-Chimique*, March, 1900.

Electro-Chemical Apparatus.—*Extraction of Gold and Silver.* Description of a device patented by Tatro and Delins, in which the ore is powdered and passed through a sieve containing 32 meshes per square centimetre; the metals not required are solved by acids and precipitated by alkalies and the pasty mass treated by a special electrolytical process. (Ill.) ½ col.—*Ztschrft. f. Elektrochem*, May 17th, 1900.

—— *Amalgamator.* An apparatus invented by Baricks, intended to increase the efficiency of the action of mercury during the amalgamation of gold, silver, platinum, copper and other metals. (Ill.) ½ col.—*Ztschrft. f. Elektrochemie*, May 17th, 1900.

2. Electric Lighting.

Accumulators.—*Accumobile-Batteries with reference to Requirements and Work.* By Mr. Vollmer, Engineer. The author gives a concise critique of the efficiency of various types of accumulators for automobiles and discusses the requirements of the various automotor systems. 2 cols.—*Electrotechniker*, April 30th, 1900.

—— *The Gas Polarisation in Lead Accumulators.* By W. Nernst and F. Dolezalek. The article describes the results of research regarding the subject carried on at the Institute of Physical Chemistry of the University of Gottingen. 3½ cols.—*Ztschrft. f. Elektrochem*, May 10th, 1900.

Electric Lamps.—*Development of the Nernst Lamp.* Extracts translated from the *Elektrotechnischer Anzeiger* of Berlin, giving an account of some of the efforts made to produce a commercial type of the Nernst Lamp. (Ill.) 2½ cols.—*Electricity* (London), May 11th, 1900.

Electric Lighting.—*Exposition of 1900.—Distribution of Electric Energy Within the Precincts of the Exposition, Illumination of the Gardens.* The article describes the method by which the electric energy supplied is distributed within the Exposition grounds, with special reference to electric lighting. (Ill.) 6½ cols.—*Génie Civil.*, May 5th, 1900.

—— *The Protection of Insulated Wires for Electric Light and Power Inside Buildings.* By Sydney F. Walker. The author discusses the merits and defects of the various methods employed for the purpose and suggests improvements. 2¾ col. and 2 cols. respectively—*Elec. Rev.*, May 4th and 11th, 1900.

3. Power.

Dynamos.—*Alternate Current Measurement.* By John Hertner. The author gives a very popular and easily grasped account of alternate current measurements, and, instead or using trigonometrical calculations, employs simple arithmetic merely, so that the arguments can be followed even by those who have no special mathematical knowledge. (Ill.) 6 cols.—*Engr.* (Cleveland), May 1st, 1900.

Electrical Distribution.—*Voltage Equalizers for the Three-Wire Systems.* By F. S. Hickok. The author describes the various methods in use for securing the advantages of the well-known three-wire system, by using only a single dynamo, with or without some additional form of voltage equalizing devices. 4¾ cols.—*West. Elect'n.*, May 5th, 1900.

—— *One and Two-Wire Systems of Electric Distribution comparatively discussed.* By Alton D. Adams. This is a reprint of the article in *Marine Engineering*, May issue, quoted elsewhere. 5 cols.—*Elec. Rev.* (New York), May 9th, 1900.

Electrical Plant.—*The Paris Exhibition.—III.—The Power and Lighting Station.* The article deals with the supply of electrical current for the Exhibition buildings and grounds, which require an expenditure of 20,000 h.p. (Ill.) 10 cols.—*Stahl u. Eisen*, May 15th, 1900.

—— *Engineering Tests on Direct Current Electrical Machinery, with Preliminary Tests on the Properties of Conductors.* By George F. Sever, Instructor in Electrical Engineering, Columbia University, U.S.A. This paper describes the tests that are assigned to the third year civil and mining engineer students at the University, and is well adapted also for students in engineering courses who do not make a speciality of electrical engineering, but who subsequently, in the pursuit of their professions, may be called upon to pass upon the merits of such types of machines as are described in the paper. 23 pages. —*School of Mines Quarterly, Columbia Un.* (N.Y.), Jan., 1900.

—— *One and Two-Wire Systems of Electric Distribution, comparatively discussed.* By Alton D. Adams. The author discusses the comparative advantages of the two systems and points out how great the impulse is that has been given toward the adoption of the one-wire system by the constructors of the *Oceanic*. 4¼ cols.—*Mar. Engrg.*, May, 1900.

—— *The Calculation of Distributing Systems of Electric Traction under British Conditions.* Abstract of a paper by F. M. Sayers. (To be continued.) 3½ cols.—*Elec. Rev.*, May 11th, 1900.

Electrical Plant.—*Willesden Electric Supply Works.* Description of this new station of the Metropolitan Electric Supply Company, Ltd. The capacity of these works, when completed, will be 45,000 indicated horse power. At present, however, not quite a quarter of this plant has been installed. (Ill.) 2¾ cols.—*Engr.*, May 4th, 1900.

—— *American Central Station Design.* Description of some of the details of the dynamos in the New York Metropolitan Street Railway Company's Station. (Ill.) 2 cols.—*Elec. Engr.*, May 11th, 1900.

—— *The Central Station Situation in the City of Chicago.* The article deals very fully with the development of the central Station supply in the City of Chicago, which offers peculiar advantages and peculiar difficulties, and therefore involves a great number of interesting problems. (Ill.) 11½ cols.—*Elec. Wrld. and Engr.*, May 12th, 1900.

—— *The Boiler and Power Plant at the Champs de Mars; the Chateau of Electricity and the Water Palace.* Summary description of the above-named features of the Paris Exhibition, illustrated by plans and sections. (Ill.). 12 cols.—*Dingler's Polyt. Journ.*, May 19th, 1900.

—— *The Polyphan Distributing System of the Metropolitan Street Railway Company of New York City.—VI.* By J. E. Woodbridge. The present instalment continues the description of this remarkable plant and deals more particularly with the high-tension feeders and the location and equipment of the sub-stations. (To be continued.) 2 cols. (Ill.).—*Elec. Wrld. & Engr.*, May 12th, 1900.

—— *The American Engines and Generators at the Station of the Metropolitan Electric Supply Co., London, England.* Description of the equipment of the plant at Willesden, consisting of three units of the Westinghouse type, each engine yielding from 2,500 to 3,500 h.p. and being direct connected with a generator of 1,500 k.w., to which a fourth unit is about to be added, identical in power with the others. The plant is intended to provide for the requirements of a connection of two million lamps. (Ill.) 2½ cols.—*Power*, May, 1900.

—— *Coventry Corporation Electricity Works.* The article describes the interesting electrical plant of the Coventry Corporation, consisting at first of two Lancashire boilers each capable of evaporating 5,000 lbs. of water per hour; a Green's economiser; two horizontal low-speed driven generating sets of 50 and 100 k.w. respectively; a Worthington jet condenser and a switchboard of the Lowrie-Hall plug type. To this was added a year later a similar set of 200 k.w., and two additional Lancashire boilers with extensions to the economiser, &c., while lately a direct coupled Belliss-Fynn set of 300 k.w. has been added. (Ill.) 5½ cols.—*Elec. Rev.* (London), May 18th, 1900.

—— *Installing a 1,500 Horse-power Generating Set.* The article deals with the latest and most important addition to the equipment of the No. 5 station of the Chicago-Edison Company at Market and Washington streets, Chicago, which may be considered the final installation at this plant. (Ill.) 2½ cols.—*Mod. Mach.*, May, 1900.

—— *New Wheel-Pit of 55,000 Horse-Power Capacity at Niagara.* Description of the turbine installation which is to be placed in the new wheel-pit of the Niagara Falls Power Company, and will be of the highest type of modern machinery, displaying several new and important features of great interest to the engineering world. 2½ cols.—*Mod. Mach.*, May, 1900.

—— *Systems and Efficiency of Electric Transmission in Factories.* Abstract of a paper by William S. Aldrich, presented at the Cincinnati Convention of the American Society of Mechanical Engineers, and dealing with transmission systems suitable for factories. (Ill.). 6 cols. —*Engrg. Rcd.*, May 19th, 1900.

—— *Electric Light and Power at the Paris Exposition.* The article deals with the enormous plant for light and power-supply laid down at the Paris Exposition, which is probably the largest and most interesting in existence. (Ill.) 9½ cols.—*Elec. Wrld. & Engr.*, May 19th, 1900.

—— *The Paris International Exhibition.—The Power Stations.* The present instalment deals chiefly with the general arrangements and the actual condition of the power-station of the Exhibition, including the steam

boilers, engines, electric generators, and the many auxiliary appliances by which energy, whether for lighting or for motive power, will be distributed through the wide area of the Exhibition grounds. Since one great source of interest at the Exhibition is machinery in motion, and as the chief popular attraction depends upon the illuminations at night, no part is of more importance than the power-station. (Ill.) 9 cols.—*Engrg.*, May 11th, 1900.

—— *The Construction of the Municipal Electricity Works (at Vienna).* Outline sketch of the plan for electrical supply stations to be built by the municipality of Vienna, adopted on May 4th, and providing for two central stations; one to supply the urban tramway lines, to consist of five units of 3,000 h.p. each; the second to supply current for lighting and various other uses, to consist of three units of 3,000 h.p. each. The construction has been entrusted to the Austrian branch of the Schuckert Company. 1 col.—*Electrotechniker*, May 15th, 1900.

Electric Motors.—*Rotary Converters.* By Hans Sigismund Meyer. Translation of an article recently published in the *Elektrotechnische Zeitschrift.* The article deals with a converter which, though it has found but a limited employment so far in Europe, is in very common use in the United States to the extent of many thousand of horse-power. 4 cols.—*Elec. Engr.*, May 4th, 1900.

Power Transmission.—*On Distant Electric-Power Transmission.* By Prof. George Forbes, F.R.S. The author devotes the first part of his paper to the description of certain selected transmission plants, each one put up by a different contractor, and each one having some special point of interest. The second part of the paper deals with some of the problems that face the consulting engineer in his attempts to introduce the highest economy, especially in the transmission lines. 5 cols. and 7 cols. respectively.—*Elec. Engr.*, May 4th and 11th, 1900.

—— *Prof. Forbes on Distant Power Transmission.* This is a communication containing various comments and criticisms on the lecture on the subject delivered by Prof. George Forbes before the Institution of Electrical Engineers. 6 cols.—*Elec. Rev.*, May 4th, 1900.

—— *Developments at Niagara.* By Orrin E. Dunlop. The author describes the remarkable progress made within a few years by both the Niagara Falls Power Company and the Niagara Falls Hydraulic Power and Manufacturing Co., and the more recent improvements in the plant. (Ill.). 2½ cols.—*Elec. Rev.*, May 4th, 1900.

—— *Waterwheel Regulators and Governors.* By Frank C. Perkins. The author deals with the regulating and governing devices employed in the latest installations, using waterwheels as prime movers. 2½ cols.—*West. Elect'n.*, May 5th, 1900.

—— *Electric Power Transmission of Southern California.* Short account of the various power transmission plants in Southern California, which contains a greater and more diversified number of electric power transmissions than any other section of equal extent in the United States. 3 cols.—*Journ. of Elec. Power and Gas*, March, 1900.

4. Telegraphy and Telephony.

Telephones.—*The Telephoning of London by the Post Office.* (To be continued.) The article gives, in connection with the laying of underground mains to be inaugurated by the London Post Office, a few particulars of the area to be served, and the exchanges to be established, together with some preliminary notes on the cables to be employed, the conduits and manholes to be constructed, and the switchboards and the method of working to be adopted. 3 cols.—*Elec. Rev.*, May 11th, 1900.

Electric Cables.—*Messrs. Rickards' Cable Factory at Derby.* Description of the plant and equipment of an important British cable factory, which, moreover, is distinguished as the factory in which the first length of silk-covered copper wire for use in electric apparatus was manufactured. (Ill.) 2 cols.—*Elec. Rev.* (London), May 18th, 1900.

Cable Steamer.—*The New Telegraph Steamer, "Von Podbielski."* By Prof. Jamieson. Continuation. 3 cols.—*Elec. Rev.*, May 11th, 1900.

5. Miscellaneous.

Electrical Equipment.—*Messrs. Ferranti's Hollingwood Works.* The article deals with some of the principal products of a firm, the founder of which played an important part in the modern development of the electrical industry of Great Britain. (Ill.) 7½ cols. (To be continued.)—*Elec. Engr.*, May 18th, 1900.

Electrical Appliances.—*Messrs. Ferranti's Hollinwood Works.* (Continuation). The present instalment deals mainly with the switch and rectifier department, and describes various ingenious devices constructed by the firm. (Ill.). 4½ cols.—*Elec. Engr.*, May 25th, 1900.

Electrical Applications.—*The Development of the Electric Drive for Cotton Mills.* Abstract of a paper by Mr. Sidney B. Paine, of the General Electric Co., U.S.A., read at the meeting of the Southern Cotton Spinners' Association on May 10th, 1900, dealing with the development of the electric drive for operating cotton mill machinery. 1½ col.—*Engrg. News*, May 17th, 1900.

—— *Electricity applied to Mining.* By Harold Bentham. Discussion of a subject constantly increasing in importance since, as the author points out, the day is not distant when the largest and most important collieries will be equipped throughout with motors for all power purposes. (To be continued.) 3½ cols.—*Elec. Engr.*, May 11th, 1900.

—— *Electricity applied to Mining.* (Conclusion.) The present instalment deals with the motors in use, electric coal cutters, comparison of first costs and efficiencies, together with comparison of working costs, lighting, cables, wiring, lamps and cables in shaft. (Ill.) 3½ cols.—*Elec. Engr.*, May 18th, 1900.

Electrical Engineering. — *The Relations between Electricity and Engineering.* By Sir William Henry Preece, K.C.B., F.R.S. Abstract of the "James Forrest" Lecture delivered by the author before the Institution of Civil Engineers. The author illustrates his subject on the basis of the four great principles underlying the practical application of electricity: (1) The establishment of a magnetic field; (2) the establishment of an electric field; (3) the disturbance or undulation of the ether; (4) the work done by the generation and maintenance of electric currents in material systems. 10 cols.—*Contr. Journ.*, May 2nd, 1900.

Electrical Exhibits.—*Some Notes on the Electrical Exhibits at the Paris Exhibition.* By E. Kilburn Scott. A communication on the subject, giving the data of a Willans engine and a Parsons turbine. 3 cols. and 2½ cols. respectively.—*Elec. Rev.*, May 4th and 11th, 1900.

—— *The Paris Exhibition.* By Charles Lemoine. Outline description of the instalment and equipment of the electrical plants at the Paris Exhibition. (Ill.). 4½ cols.—*Electricity* (New York), May 9th, 1900.

Electrical Progress.—*Electricity at the Paris Exposition of 1900.* The article deals concisely with the general features of the Exposition, and fairly fully with all that refers to electricity and its applications, describing lighting and power plants, generators, distribution, special exhibits, &c. (Ill.). 16½ cols.—*Elec. Wrld. & Engr.*, May 5th, 1900.

Electrical Measurements. — The only methods available up to a very recent date for the determination of the actual relation between the potential difference of an alternating current and the current itself were highly laborious, involving as they did the determination of the curves point by point. Some years back, Professor Blondel succeeded in substituting, by means of an instrument he named oscillograph, an autographic arrangement for the point by point method of curve tracing then in vogue, but though he did obtain some interesting results his instruments did not come into general use, and it remained for a young English engineer, Mr. W. Duddel, to overcome the practical difficulties involved and to devise an instrument capable of meeting the severest requirements. This instrument is fully described in the present article. 1½ col. (Ill.).—*Engrg.*, May 4th, 1900.

Electrical Progress.—*The Developments in Electrical Engineering.* Editorial discussing the recent progress and future development of electrical engineering in

Great Britain. The author alludes to the interesting plant of the Central London Railway, using a three-phase system converted into continuous current by rotary converters; to the experiment on the London Metropolitan Railway; the Baker Street and Waterloo Railway plant in course of construction; and statistics recently published by Mr. Gibbings, shewing that Edinburgh possesses no fewer than 385 motors connected to the mains, Liverpool 237, Manchester 464, of an aggregate of 1,601 h.p., and advocates the supplying of motors for small industries on easy terms or under a hiring arrangement as an efficient means for promoting progress in the use of electrical energy for power. 2⅜ cols.—*Mech. Engr.*, May 26th, 1900.

Electricity.—*Electrical Units.* Communication by Prof. Emil Budde, of the firm of Siemens and Halske, in Berlin, referring to the proposals by Prof. Fessenden for altering the practical electrical units, a proposal that will most likely be discussed during the congress at the Paris Exhibition in August. 2½ cols.—*Elec. Engr.*, May 11th, 1900.

Engineering Schools.—*Electrical Engineering at Purdue University, Lafayette, Ind.* The article describes the very complete equipment for the teaching of electrical engineering in the Purdue University, Indiana, which is at present one of the leading technical colleges of the United States. (Ill.) 10 cols.—*Elec. Rev.* (New York), May 9th, 1900.

Frictionless Meters.—*The Evershed Meter.* Description of an apparatus described in the beginning of May last by the inventor, Mr. S. Evershed, before the Institution of Electrical Engineers as a "Frictionless Motor Meter," which is attracting a great deal of interest and attention, and seems to offer a solution of the problem of the motor meter in quite a novel manner. (Ill.) 1 col. —*Elec. Rev.* (London), May 25th, 1900.

Galvanometers. — *Hints respecting the Internal Economy of Reflecting Galvanometers.* By J. Warren. The author points out the many difficulties in the way of successful manipulation of these galvanometers and gives very practical hints for their use, gathered from his many-sided experience. 2¾ and 1¾ cols. respectively.—*Electricity* (London), May 4th and 11th, 1900.

Speed Regulator. — *The Gime Speed Regulator.* Article translated from *La Vie Scientifique*, in which is described a device invented by M. Gimé for regulating the speed of revolving dynamos so as to prevent a change when the load is decreased or increased. From the data given it appears that the object is attained in a simple and efficient manner. 2 cols.—*Electricity* (New York), May 2nd, 1900.

MARINE ENGINEERING AND SHIPBUILDING.

Cable Steamer.—*The New Telegraph Steamer "Von Podbielski."* By Prof. Jamieson, M.Inst.C.E., F.R.S.E. The article reviews the special features of construction and outfit of the most recently built telegraph steamer and the first one owned by a German firm. (Ill.). 1⅞ col. (To be continued.)—*Elec. Rev.*, May 4th, 1900.

Floating Dock.—*700-foot Floating Dock at South Brooklyn.* The fleet of Atlantic Mail Steamers, including some of the largest vessels of the world, makes, with few exceptions, New York its destination. Whenever disaster has overtaken one of these big ships in its Westward passage it has been necessary for it to go to some other port than New York for dry-dock repairs, as New York had not the necessary accommodation. This condition of things is soon to be remedied by the construction of a large floating dry dock at Brooklyn, described in this article. (Ill.) 2 cols.—*Sci. Am.*, April 21st, 1900.

Launches. — *Messrs. Simpson, Strickland & Co.'s Specialities.* The article describes a number of that firm's steam launches, built in Dartmouth, South Devon, and distinguished by great speed and shallow draught. (Ill.) 3 cols.—*Steamship*, May, 1900.

Merchant Vessels.—*Revival of the American Merchant Marine.* Editorial describing the gradual decay, since the great war, of the United States merchant marine, and supporting the scheme at present before Congress, of paying bounties for fast vessels, thus encouraging the building of ships of which the ever-growing commerce of the United States is sadly in need. 1⅛ths col.—*Sci. Am.*, May 5th, 1900.

Merchant Vessels. — *The Progress of the German Mercantile Marine.* The article is a digest of the reports of the principal shipping companies of Germany, showing the remarkable development of the German mercantile marine. 2⅜ cols.—*Engr.*, May 11th, 1900.

Propeller Shafts.—*Propeller Shaft Failures, Defective Tail Shafts, and Triple Expansion Engines.* Abstract of papers by Mr. Edward Nicholl, R.N.R., and Mr. G. O. Mason, read at a recent meeting of the Bristol Channel Centre of Marine Engineers. Mr. Nicholl thinks that we need not search for an explanation of broken tail-shafts other than that they have been made ridiculously too small for the work they have to do; either propeller shafts must be, therefore, considerably increased in diameter or the ships must be put down deeper in water. Mr. Mason attributes the breaking before the adoption of the triple expansion engine to "shafts out of line" and to "weakness." He attributes, however, the breaking in more recent times to "the advent of the thin crank triple engines of the present day, coupled with the unfortunate reduction of strength allowed in Lloyd's and Board of Trade rules for increased number of cranks in triple and quadruple engines." 5¼ cols.—*Steamship*, May, 1900.

Ship-Building.—*Ice Breakers.* The article deals with the historical progress of ice breaking ships, of which the first was designed by the Russian merchant Britneff, and describes the "Sampo" and "Ermack," built according to the designs of the Russian Admiral Makaroff. (Ill.) 4 cols.—*Ztschrft d. Oest. Ing. u. Arch. Ver.*, May 11th, 1900.

—— The *Ivernia.* Full description of a new Cunard-Line Steamer of 25,000 tons displacement, destined for the trade with Boston, and equipped in the most modern style, not so much constructed for speed as for traffic earning. The article is richly illustrated. 10 cols.—*Mar. Engr.*, May 1st, 1900.

—— *Particulars of the Long Island Sound Steamboat. Chester W. Chapin* Description of the newest of the fast freight and passenger steamers of Long Island Sound, a fine twin-screw steamer built at the Maryland Steel Co.'s Shipyard at Sparrow's Point, for the New Haven Steamboat Co. 1½ col.—*Marine Engrg.*, May, 1900.

—— *New Type Steamship.* The article describes the *Tampico*, built at Toledo, Ohio, U.S.A., and designed for both ocean and lake service. It is constructed to carry 2,000 tons of grain on the route between the head of the Lakes and Montreal, on a draft of 14½ ft. of water, while on the sea-coast, where there is plenty of water, it will be able to carry 3,000 tons on 20 ft. (Ill.) 2 cols. —*Naut. Gazette*, May 10th, 1900.

—— *German Shipbuilding and Auxiliary Industries.* By Prof. Oswald Flamm. The author reviews the historical development of ship-building in Germany, and concludes with the opinion that the ship-building industry in Germany is at present equal to the best anywhere in the world and able to produce the highest kind of work entirely independent of any other country. 8 cols.—*Stahl u. Eisen*, May 1st, 1900.

Ship-Repairing.—*Repairs of Hulls and Machinery of Modern Ships.* Abstracts of a paper read before the Scientific Society of the Glasgow Technical College, by Mr. John White Boyd, M.I.N.A., etc., dealing chiefly with wear and tear and the means to obviate it, and the repairs rendered necessary by faulty construction or material. 3 cols.—*Naut. Gazette*, May 3rd, 1900.

Steamships. *Notable Incidents in Early Ocean Steam Navigation.* No. II. The present article deals with the damage done to, and the repair of, the Mail Steamship *Cæsus*, a ship of 280 ft. long, 43 ft. beam, 33 ft. 6 in. deep in hold, and 2,500 tons burden, fitted with steam engines of 400 nominal h.p. 4½ cols.—*Engr.* May 4th, 1900.

MECHANICAL ENGINEERING.

1. Boilers, Furnaces and Fuel.

Boilers.—*Combined Shell and Water-Tube Boiler.* Description of a water-tube boiler, comprising an outer and inner shell similar in construction to the shell and

fire-box of a vertical tube boiler. In the column are arranged a number of radially extending water-tubes, each of which contains a small circulating tube. The feed water is introduced into the water legs below the grate. The usual form of central column or "porcupine" boiler is set in brick, the greater volume of water being contained in the column. The inventor, however, desires to utilise a part of the heat which would be taken up by the ordinary setting, in providing a water-surmounted furnace, which in turn is adapted to be inclosed by a brick setting. Owing to the larger diameter of the shell the pressure cannot be carried as high as would be possible if the shell feature had been omitted. The inventor is Mr. A. Cooke, Nashville, Tenn, U.S.A. 1⅛ col. —*Engr.* (Cleveland), May 1st, 1900.

Boilers.—*The Influence of Circulation in Evaporation.* Abstract of a paper by Mr. George Halliday, read before the British Institute of Marine Engineers, in which are described some experiments showing a decrease in the rate of evaporation in consequence of increase in the rate of circulation through the tubes of water-tube boilers. 2½ cols.—*Power*, May, 1900.

—— *The Design of Flange Formers.* The designing of formers or dies for flanging boiler heads and similar work in a hydraulic press is not so simple and easy a matter as it might appear on first thought, and the writer publishes in the present article the results of operations of this kind carried on by him during a long and varied experience.—*Mech. Wrld.*, May 25th, 1900.

Blast Furnaces.—*New Blast Furnace Plant.* Description of a modern blast furnace plant for the Martiny Iron and Steel Company of Trenton, O., U.S.A., designed and built by Mr. Walter Kennedy, which is distinguished by great simplicity and efficiency. 3½ cols. —*Am. Mftrr.*, May 3rd, 1900.

—— *The Cavallier Dust Catcher for Blast Furnaces.* Description of a device for filtering the dust from blast furnaces, which has been adopted with successful results at the blast furnaces of Pont-à-Mousson, France, and was designed by M. Cavallier. (Ill.) ½ col.—*Coll. Guard.*, May 18th, 1900.

—— *On the Utilisation of Blast Furnace Slag.* By Ritter Cecil von Schwarz. The author points out that the question of the utilisation of blast furnace slag has caused a great deal of trouble and even embarrassment to managers, and then describes a method only quite recently devised in Germany which has given everywhere the best results with reference to strength, voluminal constancy and reliability, for the manufacture of cement. (Ill.) 2½ cols.—*Iron and Coal Trds. Rev.*, May 11th, 1900.

—— *The Utilisation of Blast Furnace Slag.* By Ritter Cecil von Schwarz. Abstract of a paper read before the Iron and Steel Institute, May, 1900. 2 cols.—*Coll. Guard.*, May 11th, 1900.

—— *On the Utilisation of Blast Furnace Slag.* By Ritter Cecil von Schwarz. The author describes a method recently practised in Germany to manufacture cement out of blast furnace slag which has given the best results with reference to strength, voluminal constancy, and reliability. 2 cols.—*Iron & Steel Trds. Journ.*, May 19th, 1900.

—— *An American Blast Furnace Plant.* Description of the character and engineering features of a large blast furnace plant in course of construction for the Columbus Iron and Steel Company of Columbus, Ohio, U.S.A., which is distinguished by the selection of only such features as have already been practically tested. (Ill.) 1⅛ col.—*Coll. Guard.*, May 25th, 1900.

—— *A New American Blast Furnace Plant.* Description of a new blast furnace plant under construction at Columbus, Ohio, of which particulars were given in *Iron Age*, for the Martiny Iron and Steel Company. The engineer is Mr. Walter Kennedy, of Pittsburgh. (Ill.) 1⅛ col.—*Iron & Coal Trds. Rev.*, May 18th, 1900.

—— *The Use of Liquid Fuel.* The article points out that at a recent meeting of the Society of Civil Engineers of France the question of liquid fuel for warships was raised, and that M. R. Soren has drawn attention to the fact that England intends to profit by some new sources of coal oil for establishing supply stations for the routes to the extreme East, and contains a digest of the results obtained from the use of liquid fuel on ocean vessels. 5½ cols.—*Génie Civil*, May 12th, 1900.

Blast Furnaces.—*Furnace Charging Apparatus.* Description of a furnace-charging apparatus invented by Mr. Peter Charles Patterson, of McKeesport, Pa., especially adapted for the charging into the furnace of large plates necessary in the making of large welded tubing. 2½ cols. —*Am. Mftrr.*, May 31, 1900.

—— *Caddy & Co.'s Patent Furnace Specialities.* Description of various devices securing perfect coal combustion in furnaces and the economical burning of coal, invented and constructed by the above-named engineering firm at Daybrook Ironworks, Nottingham. (Ill.) 3 cols.—*Steamship*, May, 1900.

—— *Mechanical Smokeless Furnace.* The article describes the advantages of a stoker devised by the Playford Stoker Company, U.S.A., and the economics of firing by the chain-grate system. (Ill.) 2 cols.—*Am. Mftrr.*, May 17th, 1900.

—— *Utilisation of Blast Furnace Gas in Engines.* The article discusses the quality and quantity of the gases produced by blast furnaces, their present utilisation, future utilisation thanks to their use in motors, the principal engines that lend themselves to such utilisation, and blowing engines, driven by these motors. 6½ cols.— *Coll. Guard.*, May 25th, 1900.

—— *The Open-Hearth Continuous Steel Process.* By Benjamin Talbot, of Pencoyd, Pennsylvania. The author describes a process for the continuous production of open-hearth steel put into practice by him last September in the Pencoyd Steel Works, Pencoyd, Pennsylvania, and the excellent results obtained by him. 1½ col. —*Iron & Steel Trds. Journ.*, May 12th, 1900.

—— *The Use of Fluid Metal in the Open-Hearth Furnace.* By James Riley. The author expresses his astonishment that, although the transfer of fluid metal into the Bessemer converter direct from the furnace had become general, so little interest had been shown in the parallel case of the use of fluid metal taken directly from the blast furnace to the open-hearth furnace. He describes a number of experiments and their results, and concludes with the assertion that the important series of advantages of this method enumerated by him has convinced him that eventually the direct fluid metal process in open-hearth furnaces will be generally adopted. 4½ cols.—*Iron & Steel Trds. Journ.*, May 12th, 1900.

—— *Direct Open-Hearth Process.* The article describes a new apparatus for manufacturing open-hearth steel, devised by Messrs. Samuel T. and Charles H. Wellman, of Cleveland, O., U.S.A., in which the molten metal is poured into moulds, desiliconised and the furnace charged with hot ingots. 1 col.—*Am. Mftrr.*, May 17th, 1900.

Stoking.—*Day's Ideal Fuel Feeder.* Description of a pulveriser and fuel feeder using all grades of soft coal, without smoke, and being so devised as to fulfil all important requirements. Its main advantages are said to be that it saves fuel, shows greater efficiency in the generation of steam, and secures a longer life to the machinery. 1¼ col.—*Am. Mftrr.*, May 17th, 1900.

2. Compressed Air.

Air Hoists.—*The "Sentinel" Air Hoist.* The article describes in detail the design and construction of the so-called "Sentinel" Air Hoist, built at the "Sentinel" Works of Messrs. Alley and Maclellan, Glasgow, Scotland, which is made with cylinders from 4 to 20 inches in diameter, lifts of 4 to 10 feet, and is able to lift from 500 to 20,000 pounds, using the ordinary air pressure of 5 to 6 atmospheres. (Ill.) 1¼ col.—*Am. Mach.*, May 3rd, 1900.

Air Compressors.—*Explosions and Ignitions in Air Compressors and Receivers.* By Alfred George White. The author describes a recent occurrence of an explosion, and analyses its causes in the hope that it may help others to comprehend the question and to find a means of avoiding the explosions and ignitions in air compressors. 2¼ cols.—*Contr. Journ.*, May 18th, 1900.

3. Engines and Motors.

Air Pumps.—*The Edwards Patent Air Pumps.* Description of a very interesting and efficient type of air pump which is now being very largely adopted, not only

for marine engines, but also for mineral, electrical, and other land installations, and well deserves to be studied with regard to its more important features. (Ill.) 1¾ col.—*Steamship*, May, 1900.

Automobiles.—*The Ordinary Types of Automobiles.* By Prof. H. Bachner, of Stuttgart. (Continuation.) This instalment deals with the charging of accumulators. 6 cols.—*Dingler's Polyt. Journ.*, May 5th, 1900.

—— *The Ordinary Types of Automobiles.* By Prof. H. Bachner, Stuttgart. (Continuation.) The present instalment is devoted to peculiar forms of energy supply, among them the method used in the motor-trolley of Lombard-Gerin, of which an experimental line is working just outside Paris. 4 cols.—*Dingler's Polyt. Journ.*, May 12th, 1900.

—— *The Automobile and Motor Car Exhibition.* Summary account of the exhibits shown at the exhibition held from April 12th to 21st at the Agricultural Hall, Islington, in wh ch nearly all the main important features of motor car construction were represented. (Ill.) 6 cols.—*Carr. Bldrs.' Journ.*, May, 1900.

—— *The Lubrication of Motor Vehicles and Cycles.* Digest of an interesting and useful pamphlet on the subject by Mr. J. Veitch Wilson, and published by Price's Patent Candle Company, Ltd. 2¼ cols.—*Autom. Journ.*, May, 1900.

—— *The De Dion-Bouton Voiturette.* This little vehicle, recently placed upon the market, has attracted considerable attention owing to the reputation of the firm and the popularity of its well known tricycles. It will most probably find a considerable sale, as great care is shown in the design, and the whole arrangement of details is evidently the result of extensive experience. (Ill.) 1¼ col.—*Autom. Journ.*, May 12th, 1900.

—— *The Thousand-Mile Trial.* Editorial paying high tribute to the Automobile Club and the indomitable energy of Mr. Claude Johnson, the secretary, concluding with the hope that the 1,000 mile trial will become a hardy annual. 1¼ col.—*Autom. Journ.*, May, 1900.

—— *The Renaux Motor Tricycle.* The article deals with a motor tricycle constructed on lines entirely differing from the well-known De Dion machines, and is a very ingeniously devised machine. Its special characteristics are that the differential gearing is incorporated into the motor itself, that roller bearings are used upon the crank pin and for the main bearings of the motor; that the motor and transmission shafts are practically in one line with the wheel axles, and that the motor itself forms an essential part of the frame. The machine is very difficult to describe in outline, and a reference to illustrations is necessary. (Ill.) 1 col.—*Autom. Journ.*, May, 1900.

—— *The New Orleans Voiturette.* Description of a voiturette designed and constructed by Messrs. Burford, Van Toll & Co., of Twickenham, which has attracted a good deal of attention both at the recent exhibition in the Agricultural Hall and also on the occasion of the 1,000 mile trial. (Ill.) 1 col.—*Autom. Journ.*, May, 1900.

—— *Hub-Motor Vehicles for Chicago.* Description of a system of electrically propelled omnibuses in Chicago, running from the centre of the city to the parks on the North, West, and South side, and furnished with a peculiar motor equipment devised by Messrs. F. J. Newman and J. Ledwinka, and manufactured exclusively by the Hub Motor Company. (Ill.) 2 cols.—*West. Electn.*, May 12th, 1900.

Blowing Engines.—*On a Blowing Engine Worked by Blast Furnace Gas.* By A. Greiner. The author, in a paper read before the Iron and Steel Institute, describes the results obtained at the Cockerill Works at Seraing, Belgium, with the first blowing engine worked by blast furnace gas ever employed in any ironworks. (Ill.) 2½ cols.—*Iron and Coal Trds. Rev.*, May 11, 1900.

Engines.—*The Paris Exhibition—I.* The article, after a few introductory remarks, describes in outline the machinery and electricity buildings, and then gives the more important dimensions of a very fine triple expansion engine exhibited and constructed by Messrs. Willans and Robinson, Ltd., Rugby. (Ill.) 1 col. (To be continued.)—*Mech. Wrld.*, May 18th, 1900.

Engines.—*The Engines of the Corvette "General Baquedans."* By Magnus Sandison, Esq., M.I.N.A. Description of a set of six cylinder engines possessing some novel features, and solving with a considerable measure of success and in a simple manner some important problems that have of recent years attracted attention. (Ill.) 3 cols.—*Mar. Engr.*, May 1st, 1900.

—— *Triple Expansion Engines for the Dutch Armoured Cruiser "Noord Brabant."* Description of the triple expansion engines constructed from the designs of Mr. W. H. Martin, engineer, at the works of the "Royal Company of Workshops and Dockyards of the Scheldt," at Flushing, for the Dutch cruiser *Noord Brabant*. These engines possess several novel and very interesting features. (Ill.) 8 cols.—*Génie Civil*, May 12th, 1900.

—— *Ljungstram's Crankless Engine.* Description of this new type of engine invented by a Swedish engineer, which is now being introduced into the market by Messrs. Dunford and Elliott, of Newcastle-on-Tyne, and has given excellent experimental results. (Ill.) 2½ cols. —*Am. Mftrr.*, May 3rd, 1900.

—— *A Novel Form of Steam Engine.* The article deals with the Behrend and Zimmermann engine, which has given such excellent results in the Laboratory of the Royal Technical High School at Charlottenburg, and adds 50 per cent. of efficient power to the usual type of engine without increase of fuel. (Ill.) 1¼ col.—*Iron and Coal Trds. Rev.*, May 4th, 1900.

—— *The Engines of the s.s. "Deutschland."* Description of the engines of the powerful German steamer *Deutschland*, which is in size second only to the White Star Line steamer *Oceanic*. Her engines, however, are even more powerful than those of the *Oceanic*, since they develop 33,000 horse-power as compared with the 28,000 horse-power of the British steamer. (Ill.) 1½ cols.—*Power*, May, 1900.

—— *Crank Shafts.* By Mr. John Brady. Of all the working parts of the mechanism of a steam engine that part known as the "crank shaft" is the one that is looked upon by the engineer as the most important. The author deals in the present article with the construction of stationary and marine crank shafts, the material used, and their bearings on present-day practice. (Ill.) 2 cols. —*Engr.*, May 4th, 1900.

—— *The Naval Steam Engine—Its Graphics and Economics Illustrated—I.* By Robert H. Thurston. The author attempts an analysis of thermal and dynamic energy distributions in the steam engine into useful and wasted energies, and the tracing of the steam from its source in the fuel at the boiler furnace to and through the steam in the engine piston and on to its work, or, unutilised, from the steam and the engine cylinder into the condenser or out into the atmosphere. 6 cols.— *Mar. Engrg.*, May, 1900.

Gas Engines.—*The Modern Gas Engine.* Abstract of a paper by Mr. Jas. Dunlop, read before the British Association of Draughtsmen, at Manchester, May 3rd, 1900. (To be continued.) The author deals with the development and improvements of gas engines which are becoming more and more very serious competitors to steam engines. 7 cols.—*Mech. Engr.*, May 12th, 1900.

Gas Motors.—*Utilisation of Furnace Gases in Gas Motors.* Discussion of this very important supply of power which promises to work a revolution in the management of iron works and auxiliary industries connected therewith. (Ill.) 8 cols.—*Dingler's Polyt. Journ.*, May 5th, 1900.

Gasoline Engines.—*The Weber Gasoline Hoisting Machine.* Description of an engine of the type built by the Weber Gas and Gasoline Engine Co. of Kansas City, Mo., U.S.A., bolted to a heavy and strong base plate on which is carried the hoisting drum. The distinguishing feature of the hoist described is that all end thrust on the main drum shaft is done away with, since a toggle joint friction clutch arrangement is now used, which is very sensitive, and gives the operator full control of the load. (Ill.) ½ col.—*Engrg. and Min. Journ.*, May 5th, 1900.

Petrol Motors.—*The Monarch Motor.* Description of a motor distinguished by its cycle operations and its ignitions. It is a two-stroke engine which draws the com-

bustible charge into the crank chamber; there is no exhaust valve, but the exhaust gases are allowed to pass to the exhaust pipe, when the piston uncovers an exhaust port toward the end of its working stroke. The second feature is the low tension electric ignition, similar to that in the Mars motor. The motor is said to run quietly and steadily and to be under complete control. (Ill.) 2 cols.—*Autom. Journ.*, May, 1900.

Turbines.—*Steam Turbines and High-Speed Navigation.* C. A. Parsons. Abstract of a paper read before the Royal Institution, Jan. 26th, 1900. The author traces the history of steam engines down from its earliest records to its latest form, and among others describes the latest turbo-alternator of 1,200 kw. with 130 lbs. steam, 10 deg. C. superheat, giving 18·8 lbs. per kw. hour. 8 cols.—*Nature*, March 1st, 1900.

Steam Turbines.—*Large Steam Turbines Direct-Connected to Generators.* The article describes the plant of the Wilmerding Air Brake Company at Wilmerding, Pennsylvania, which has been in operation for several months, and in which steam turbines of the Parsons type, but greatly improved by the Westinghouse Co., which in 1896 acquired the patent rights in America, are direct connected to electrical generators. Each unit consists of a 500 horse-power steam turbine driving a 300 kilowatt, two-phase, alternating current generator. (Ill.) 4 cols.—*West. Elect'n.*, May 5th, 1900.

—— *Westinghouse-Parsons Steam Turbine Plant.* By Burcham Harding. The article gives a description of the plant of the Westinghouse Air Brake Company at Wilmerding, Pennsylvania, U.S.A. (Ill.) 5 cols.—*Engrg. Rcd.*, May 5th, 1900.

Traction Engines.—*Traction Engines in South Africa.* The article describes the excellent results obtained during the campaign in South Africa by the various types of traction engines, notably those of Messrs. Aveling and Porter, Ltd.; Charles Burrell and Sons, Ltd.; John Fowler and Co., Ltd., &c. (Ill.) 1½ col.—*Ind. and East. Engr.*, April, 1900.

—— *War and Power Traction.* Abstract of a paper read before the Automobile Club by the Right Hon. J. H. A. Macdonald, C.B., LL.D., F.R.S.S. (L. and E.), on April 21st, in which the author very emphatically insists upon the high importance of traction engines for war purposes. 6 cols.—*Autom. Journ.*, May, 1900.

—— *Road Locomotion.* Abstract of a paper read before the Institution of Mechanical Engineers by Prof. H. S. Hale-Shaw, LL.D., F.R.S., &c., dealing with the general principles of the engineering features of the question rather than with a detailed description of any particular system. (Ill.) 6 cols.—*Autom. Journ.*, May, 1900.

4. Power and Transmission.

Boring Machines.—*A Geometric Boring Tool.* Describing a boring device for boring other than round holes, which seems to be distinguished by great simplicity, giving apparently true and accurate work; the speed of drilling is estimated from one-half to two-thirds that of a twist drill, making the same size of round hole. (Ill.) 7 cols.—*Am. Mach.*, May 3rd, 1900.

Flying Machines.—*Danilewsky's Controllable Flying Machine.* Digest of a book by Dr. Danilewsky, in which he develops his theory of aërial navigation and the progress of his apparatus invented for the purpose. He claims for his apparatus that it can easily ascend and descend without throwing down ballast or permitting gas to escape; it can proceed without wind or with full wind; it can detect and select the favourable current in the various strata of air; it is simple, portable, and inexpensive. (Ill.) 8¼ cols.—*Dingler's Polyt. Journ.*, May 19th, 1900.

Hydraulic Lifts.—*Recent Developments in Hydraulic Lifts.* The author discusses the subject of really reliable hydraulic lifts, points out the branches in which better arrangement would have prevented lamentable accidents and such branches as have so far been entire failures. 6½ cols. and 6 cols. respectively.—*Mech. Engr.*, April 28th and May 5th, 1900.

Lifts.—*The Economy of Lifts.* Editorial commenting on the great economy realised by the use of lifts in high buildings and during their construction. In conclusion the author draws attention to the absurd and cruel regulation preventing servants in big hotels from using lifts, which enforces upon them frequent stair climbing, which is a very injurious kind of labour, especially for women. 1⅛ col.—*Publ. Health Engr.*, May 19th, 1900.

Power Transmission.—*Power Transmission.* By Alton D. Adams. The author discusses transmission by gas and electricity, the efficiency of gas and steam engines for generating electric power, the relative losses and expenses in transmitting power over long distances by electric wires and by gas in pipes, and the commercial limits to the practicability of each. 4 cols.—*Mines and Minerals*, May, 1900.

Spinning Machinery.—*Spinning, Doubling, Reeling and Winding.* Description of an invention having for its object a more perfect yarn clearing or cleaning device, so that it will not be chafed or broken except when a piecing, lump, or other imperfection meets the clearer. 1 col.—*Text. Industr.*, May 12th, 1900.

—— *Spinning Mules and Twiners.* Description of an improvement of self-acting mules and twiners, providing means to lock the winding faller which controls the building of the caps; it is claimed that the disadvantages in the old systems are entirely obviated. (Ill.) 1 col.—*Text. Industr.*, May 12th, 1900.

Steam Pumps.—*New Types of Direct Acting Steam Pumps.* By Prof. Fr. Freytug. The author describes a number of direct-acting steam pumps with one cylinder, i.e., simplex pumps, some of which are arranged for double expansion. 6 cols.—*Dingler's Polyt. Journ.*, May 12th, 1900.

Transporting Machinery.—*Temperley Transporting Plant at Sfax.* The article deals with a very interesting plant recently constructed by the Temperley Transporter Company at 72, Bishopsgate Street Within, London, E.C., to the order of the Compagnie des Phosphates et du Chemin de Fer de Gafsa, for erection at Sfax, Tunisia, and intended for handling phosphates. (Ill.) 1⅛ col.—*Engrg.*, May 11th, 1900.

Weaving.—*Imitation Lappet Weaving.* Description of a device for imitation lappet weaving, in which a suitable reed is used in combination with a comb, and capable of lateral movement for the guidance of the special warp threads for producing the lappet effect, and in addition the comb is capable of following the motion of the slay carrying the reed, in order to keep it constantly in close proximity to the reed. (Ill.) 1 col.—*Text. Industr.*, May 12th, 1900.

5. Machine Works, Shop & Foundry.

Machine Shops.—*Shops of Wells Brothers, Greenfield, Mass.* Description of the premises and equipment of a comparatively new factory, i.e., that of Wells Brothers, manufacturers of taps and dies in the old New England town of Greenfield, Mass. (Ill.) 1¼ cols.—*Am. Mach.*, May 3rd, 1900.

Machine Tool Shops.—*Enlarged Plant of the Bullard Machine Tool Co., Bridgeport, Conn.* Description of the extensive additions made during the past year in the plant of these well-known manufacturers of boring with turret machines and lathes; the total floor space added amounting to 32,000 square feet. (Ill.) 4 cols.—*Machinery*, May, 1900.

Machine Tools.—*Novel Lift Table and Turning Machine.* Description of a novel lifting table and shifting mechanism invented by Mr. Frank McClain, of Johnstone, Pa., U.S.A. The device is meant for use in rolling mills, being adapted to three-high continuously driven as well as two-high non-reversing mills. (Ill.) 1¼ col.—*Am. Mftrr.*, May 17th, 1900.

Screwing Tools.—*Screwing Tools for Turret Lathes.* By John Ashford, A.M.I.M.E., Head of Mechanical Engineering Department, Northampton Institute, London, E.C. The article deals with a few special screwing appliances for use on turret lathes and automatic machines. (Ill.) 7½ cols.—*Mech. Progress*, May, 1900.

6. Refrigeration.

Refrigeration.—*Ice Making and Cold Storage in North Scotland.—II.* The article describes the refrigerating plant of the North-Eastern Ice Co., Ltd., Aberdeen, which latter is a product of the steam-trawling industry which is considerably developed in that city, known not undeservedly as the "Grimsby of the North." 4 cols.—*Ice and Cld. Strge*, May, 1900.

7. Miscellaneous.

Distance Gauge.—*Primosigh's Distance Gauge.* The author describes an optical gauge for the purpose of estimating distances, invented by him, and claims for it theoretic accuracy and simple manipulation, thus distinguishing it from apparatus heretofore used, but being either too delicate or inaccurate. (Ill.) 1½ cols.—*Dingler's Polyt. Journ.*, May 19th, 1900.

Ditch-Digging.—*Effective Ditch-Digging Machine.* Description of a machine devised by Mr. Richard Dalton of Willmette for Messrs. John A. McGarry and Company of Chicago, which, although only a roughly constructed model was used, has done surprisingly good work, and will supersede, wherever possible, hand labour in ditch and trench-digging. The loosening up of the material is done by a set of ploughs which are attached to pivoted arms on a heavy wooden wheel 12 ft. in diameter. The wheel is driven by a sprocket chain which is carried around a smaller sprocket wheel, keyed on the shaft of a portable engine, forming part of the machine. The ploughs extend a little beyond a set of buckets, four of which are carried on each side of the wheel, and automatically remove the dug up material, depositing it on both sides of the ditch. Working in a very tough kind of stony hard grass this machine has dug a trench 3 ft. wide, 6 ft. deep, and 460 ft. long in only nine hours, not more than four or five men being needed to operate the digger. 1 col.—*Sci. Am.*, May 5th, 1900.

Fly-wheels.—*Fly-wheel Accidents.* Abstract of a paper by Prof. Sharp, B.Sc., read before the Civil and Mechanical Engineers' Society, April 5th, 1900. The author discusses the causes of fly-wheel bursts; analyses the fly-wheels as sources of energy, describes what are safe fly-wheels, refers to Professor Benjamin's Destructive Tests of Fly-wheels at High Speed, and concludes with a quotation from Prof. Benjamin's paper, saying that the more the subject is agitated, the less shall we have occasion to mourn the destruction of life and property on account of faults in the design of this most necessary element of the steam engine. (Ill.) 2½ cols.—*Iron and Coal Trd. Rev.*, May 4th, 1900.

Gearing.—*Epicyclic Gearing*—2. In the present instalment of his contribution the author discusses a few applications of epicyclic or spur-gearing to actual practice, showing a number of cases where it contributes largely to the success of the machines upon which it is used. (Ill.) 2¾ cols.—*Machinery*, May, 1900.

Knitting Machines.—*Round-Knitting Machine.* The article deals with a novel knitting machine placed upon the market by the Chemnitz Hosiery Works, late Schubert and Salger, Chemnitz, under the name of "Standard Round-Knitting Machine," for the knitting of stockings, which has met with great success. (Ill.) 6 cols.—*Dingler's Polyt. Journ.*, May 26th, 1900.

Philosophy of Mechanics.—*Hertz's Mechanics.* Short review of "The Principles of Mechanics presented in a New Form," by Heinrich Hertz, translated by D. E. Jones and J. T. Walley. The reviewer gives a rather concise digest but does justice to the importance of the volume in his comments. 2½ cols.—*Nature*, May 17th, 1900.

Mechanism.—*A New Mechanical Movement.* By R. C. Gabrut. The author describes what appears to be a new mechanical movement, especially useful in mechanism in which a rotary gear is to be driven for a part of a revolution at a constant speed and started and stopped with a "harmonic motion," eliminating shock. (Ill.) 3 cols.—*Am. Mfgr.*, May 17th, 1900.

Road Profiles.—*The "Orograph;" an Automatic Profile Recorder.* Description of an ingenious machine constructed for the engineering corps of the United States army, owned by a detachment of this corps, stationed at Willett's Point, Long Island, New York. It is to some extent to take the place of the surveyor's chain and level. 1½ col.—*Sci. Am.*, May 12th, 1900.

Scutching Flax.—*The Crawford System Flax Scutching Co.*, Donegal Square Buildings, Belfast. Description of a mechanical device for removing the straw and flax without wasting the fibre: for this purpose the dry flax is first broken by being crushed between grooved rollers in a specially constructed machine, known as a "breaker;" it is then cleaned and finished in a second machine, which consists of two cylinders covered with blades, having on their edges a series of serrations, causing the flax to be spread out and thoroughly cleaned; this latter machine is called "the finisher." (Ill.) 1½ col.—*Text. Mercury*, May 19th, 1900.

Telescopes.—*The Paris International Exhibition.* After giving a short outline of the proposed, and as yet unfinished, features of the exhibition, the author deals with the gigantic telescope, devised by M. Francois Delonde. 2 cols.—*Engr.*, May 11th, 1900.

Thermometers.—*Steinle's Steel Mercury Thermometers.* Description of a mercury thermometer encased in steel which permits the registering of a very high temperature with great accuracy. (Ill.) 1½ col.—*Mech. Engr.*, May 12th, 1900.

Weighing Machines.—*Large Weigh-bridges.* Description of two large weighing machines recently constructed by Messrs. W. and T. Avery, Ltd., of Soho, Birmingham, *i.e.*, a 110-ton railway weigh-bridge made for a large marine engineering firm in the North of England, and a large hot iron plate weighing machine, specially constructed for the Dowlais Iron Company. The first is intended for weighing marine engines entire before they are put on board ship. The second machine is designed for weighing a hot plate as it comes from the rolls, the maximum size of plate with which it is capable of dealing is 40 ft. by 8 ft. 9 in. Both are highly interesting machines of special design. (Ill.) 1 col.—*Engr.*, May 4th, 1900.

Weaving Looms.—*The Harriman Automatic Loom.* Description of a loom in which one of the special features claimed is the fact that ample time is taken for re-supplying the weft. To secure this end three methods have been adopted. The loom is brought to a complete standstill, a filled shuttle exchanged for a spent one, and the loom automatically restarted; or the picking is suspended for a series of picks, the speed of the loom reduced to 15 to 20 revolutions per minute, the shuttle changed and the loom restarted at its normal speed; or lastly, the picking is suspended and the shuttle shifted from the stationary magazine to the moving lay, ample time being given for such operation, because of the suspension of the picking. In the present paper particular attention is given to the stopping loom, as for a new loom running at high speed it is believed to be the most efficient of the three mechanisms. (Ill.) 3 cols.—*Textile Recorder*, May 15th, 1900.

—— *Modern Power Looms.* Review of the second edition of an excellent book entitled "Mechanism of Weaving." By J. W. Fox, dealing with the construction and working of power looms and describing tappet, dobbie, and Jacquard or harness looms. 1½ col.—*Nature*, May 10th, 1900.

—— *Weaving Pile Fabrics.* Description of a novel device in connection with the wires and mechanism for operating pile fabric looms, securing a more accurate placing of the wires in position in the shed and providing for the withdrawing hook being thrown temporarily out of operation whenever desired. (Ill.) 1½ col.—*Text. Industr.*, May 12th, 1900.

MINING AND METALLURGY.

1. Coal and Coke.

Coal Mining.—*The Coal Production of the Principal Countries of the World.* Abstract of the sixth annual statement published by the Commercial, Labour and Statistical Department of the Board of Trade; showing the production and consumption of coal, and the number of persons employed in coal production in the principal countries of the world. 2¾ cols.—*Coll. Guard.*, May 25th, 1900.

—— *The Geological Position of Trans-Mississippian Coals.* By Charles R. Keyes. The author points out the insufficient information contained on the subject in the geological maps and general literature, and dwells mainly on the stratigraphical position of seams that now, and in the future are likely to, furnish the supply. 2 cols.—*Engng. and Min. Jour.*, May 5th, 1900.

—— *The Threatened Exhaustion of Britain's Cheap Coal Supplies.* By J. Stephen Deans. I. *The Problem Stated.* The author discusses this important question and shows that the quantity of coal in existence in Great Britain has been greatly underrated heretofore. 2 cols.—*Iron and Coal Trd. Rev.*, May 18th, 1900.

Coal Mining.—*Coal Mining in New South Wales.* By Harrison F. Bulman. In this, the sixth section of his contribution, the author describes the Metropolitan Colliery, near Helensburgh which, owing to unusual difficulties encountered, occupies a unique position. The output of this colliery for the year 1898 was 195,283 tons. It employs 332 persons. (Ill.) 2 cols.—*Coll. Guard.*, May 11th, 1900.

—— *The Coalfields around Tse Chou, Shansi, China.* Abstract of a paper by Noah Fields Drake, Tientsin, China. The author, who during the months of July and August, 1899, visited the locality in question and collected some information concerning the geology and value of the above named already famous coalfields, gives in this paper the results of his investigations. (Ill.) 3 cols.—*Coll. Guard.*, May 25th, 1900.

—— *The Lanarkshire Coalfield. XXII.—Viewpark Colliery.* The present article deals with a colliery owned by Messrs. Robert Addie and Sons, Ltd., who are also owners of Rosehall Colliery in the same coalfield, and Denny Colliery in Stirlingshire. Viewpark Colliery is the most recent and is situated seven miles east of Glasgow. (Ill.) 2¼ cols.—*Coll. Guard.*, May 25th, 1900.

—— *Notes on the Working of Coal Mines under Sea.* By Mr. Thomas Bell Scarborough. The article is intended to show the depth and extent to which the coal-mines have been worked under the sea off the coast of Durham and Northumberland, and inland under the heavy feeders of water contained in the sand-bed found beneath the magnesian limestone in the county of Durham, known as the "sand feeders," without bringing the water down into the workings. 3¾ cols.—*Iron and Coal Trds. Rev.*, May 7th, 1900.

—— *The Rapid Handling of Coal and Ore.* By Arthur C. Johnston. Abstract of a paper read before the Civil Engineer Club of Cleveland, and reproduced in the "Journal of the Association of Engineering Societies." (Conclusion). 2¾ cols.—*Mech. Engr.*, May 12th, 1900.

—— *Electrical Winding and Haulage Machinery.* Abstract translated from a paper contributed on the subject by Mr. W. Müller of Ersen to *Glückauf.* (Ill.) 2¼ cols.—*Iron and Coal Trds. Rev.*, May 18th, 1900.

—— *Coal Mining and Mechanical Appliances.* By James Warnethenhall, M. Inst. C.E. Abstract of a paper contributed to the Institution of Civil Engineers, and describing the method of coal mining in use in the Cambrian coalfield in Weston County, Wyoming, about sixty-five miles south-west from Deadwood Dakota. 4 cols.—*Coll. Guard.*, May 11th, 1900.

—— *Car Dumpers and Their Work.* By Walden Fawcett. Description of the great car dumpers used at the ports of the Great Lakes in the United States where coal is transferred from railroad cars to the vessels, and by which the work is performed with the minimum of breakage. (Ill.) 2½ cols.—*Am. Mfgr.*, April 26th, 1900.

—— *New Plant at Broomhill Colliery.* By John E. O'Keefe. The author describes the new plant, now nearly completed, in Bromhill Colliery, in the County of Northumberland, two miles from the river Coquet, on the northern edge of the Northumberland, Durham and Yorkshire coalfields; the old plant was seriously damaged by fire. (Ill.) 1 col.—*Coll. Guard.*, May 18th, 1900.

—— *Working Twin Seams of Coal.—I.* By W. S. Gresley. The author deals with twin coal seams, which will be found in a great many coal mines, and gives a kind of summary of published descriptions of twin-working methods amplified by notes from his own experience, which are of interest to mining engineers and owners of coal mines. (To be continued). 3 cols. (Ill.) —*Engng. and Min. Journ.*, May 12th, 1900.

2. Copper.

Copper.—*The Electrolytic Determination of Copper.* Abstract of a paper by William E. Grainger, published in the *Record* of the University of Tennessee, describing the methods used in the laboratory of the Ducktown Sulphur, Copper, and Iron Company, Limited. In this laboratory are used three of the best known methods for estimating copper—the electrolytic, the calorimetric and the cyanide, the former being used in all important cases; the others mainly in furnace contract work. The author gives a concise account of the electrolytic method and accompanies his description with practical hints. 1 col.—*Engng. and Min. Journ.*, May 12th, 1900.

3. Gold, Silver and Diamonds.

Gold Mining.—*The Gold Zone of Copalquin, Mexico. II.—Copalquin.* The present instalment deals with the "El Refugio Mine" in the Copalquin region, Mexico. The Refugio property consists of 150,000 sq. metres, and was discovered in 1849 and the output has been phenomenal, the richest ores yielding 2,000 oz. per ton. (Ill.) 1½ col.—*Engng. and Min. Journ.*, May 12th, 1900.

——*Building an Impounding Dam for Storage Reservoir for the Consolidated Gold Fields, Johannesburg, South Africa. Interesting Mechanical Appliances.* By Frank B. Knight. The article deals with American methods applied to the recent construction of an impounding dam for the storage of water for mining purposes. 1½ col.—*Mines and Minerals*, May 3rd, 1900.

4. Iron and Steel.

Cast Iron.—*Metalloids: Their Removal or Retention in Molten Metal.* By Dr. Edward Kirk. Reproduction from the *Am. Mfrr.*, treating of cast iron as a compound of iron and metalloids in its application to the art of founding. 1¾ col.—*Iron and Steel Trds. Journ.*, May 26th, 1900.

Iron and Steel Production.—*The Metallurgy of Iron and Steel.* By Prof. A. Humboldt Sexton, F.I.C., F.C.S., &c. (Continuation). In the present instalment the author deals with the "Forge" and discusses shingling, hammers, such as the tilt hammer, the helve hammer, and the steam hammer, the effect of hammering, squeezers, further treatment of the bloom, puddled bar, the mill, shearing and piling, the mill furnace, the rolls, chemical changes in the mill, &c. (To be continued)—*Mech. Engr.*, May 12th, 1900.

—— *A New Process for the Production of Basic Open Hearth Steel from Pig and Ore.* By Ambrose Monell. Description of a process which mainly consists in adding to an initial bath of steel, charges of molten pig iron, or partly purified iron, and charges of nuts, cinders, or iron to enrich the slag as oxidised, and withdrawing an aliquot part of the steel and of slag whose oxidising capacity has been exhausted. The process depends on the desiliconising, decarbonising, and dephosphorising action of highly basic ferruginous slag upon molten impure metal. This reaction takes place during the passage of the molten metal through the liquid, pure metal with the supernatant slag, this being promoted through the fact that the incoming impure metal, being lighter, floats upon the finished purified metal which constitutes the great mass of the baths. 4 cols.—*Iron and Coal Trds. Rev.*, May 11th, 1900.

—— *Standard Specifications for Steel and Iron.* Editorial on the standard specifications formulated by the American Section of the International Association for Testing Materials, covering various grades of wrought iron and steel which were fully discussed at the regular meeting of the American Society of Civil Engineers, May 18th, 1900. 4 cols.—*Engrg Rcd.*, May 19th, 1900.

Iron Foundry.—*The Open-Hearth Continuous Steel Process.* By Benjamin Talbot, of Pencoyd, Pennsylvania. (Conclusion). Abstract of a paper read before the Iron and Steel Institute. 3½ cols.—*Iron and Steel Trds. Journ.*, May 19th, 1900.

Iron Industry.—*The Influence of Copper on Iron.* By W. Lupin, Professor at the Imperial Mining College of St. Petersburg. The author, alluding to an article in *Iron Age* on the subject, written by Albert Ladd Colby, gives a summary of his own researches supplementing the observations of Mr. Albert Ladd Colby. 0¾ cols.—*Stahl u. Eisen*, May 15th, 1900.

Iron Ores.—*Sweden's Treasure of Iron Ores.* The article is a summary of a lecture by Prof. C. Nordenström, published in the *Jernkontorets Annaler*, 1899, No. 4, and contains an estimate of the extent of iron ores in Sweden, which is of great interest if it is borne in mind that Sweden's iron production rose between 1871 and 1891 from 662,539 tons to 987,485 tons, and reached in 1892 the amount of 1,293,583 tons. 5½ cols.—*Stahl u. Eisen*, May 1st, 1900.

Pig Iron Manufacture.—*Pig Iron Breakers.* Description of two machines used in Great Britain, summarized from papers read before the West of Scotland Iron and Steel Institute; the one invented and constructed by Mr. T. E. G. Marley, the other by Mr. Enoch James. (Ill.) 2½ cols.—*Am. Mfrr.*, May 10th, 1900.

5. Mining.

Mining.—*Mine Dams. How they are built to withstand Heavy Pressures in the Iron Mining Districts of Michigan.* By James MacNaughton. The author comments on the necessity of building mine dams throughout the iron district of Michigan, and especially at the Chapin mine, where the principal shaft is located in the limestone, and where the greater part of the iron-cutting to connect this shaft with the ore body is through limestone. 2¼ cols.—*Mines and Minerals.* May, 1900.

—— *Mine Dams.* By James MacNaughton. Abstract of a paper read before the Lake Superior Mining Institute, and dealing with the subject of building mine dams, a necessity frequently arising in the iron district of Michigan, U.S.A., and especially demonstrated in the conditions of the Chapin mine. 1¾ col.—*Engrg. and Min. Journ.*, May 5th, 1900.

—— *Prevention of Accidents in Connection with Mine Passes.* Translated extracts from a communication to the *Annales des Mines de Belgique*, by Victor Watteyne, Ingénieur Principal, Directeur des Mines, and Lucien Denoël, Ingénieur au Corps des Mines. (To be concluded). 2¼ cols.—*Coll. Guard.*, May 11th, 1900.

—— *Prevention of Accidents in Connection with Mine Passes.* Translation of a communication to the *Annales des Mines de Belgique*, by M. Victor Watteyne, Ingénieur Principal, Directeur des Mines, and M. Lucien Denoël, Ingénieur au Corps des Mines. (Conclusion). 2¾ cols.—*Coll. Guard.*, May 18th, 1900.

—— *Interlocking Mine Air-Doors.* Abstract of an address of M. Martinet, chief engineer of the Commentry Colliery, to the Centre Section of the *Société de l'Industrie Minerale* in which he discussed the importance of the interlocking of air-doors and described a method for doing this without using any rigid part for transmitting motion. 1 col.—*Coll. Guard.*, May 25th, 1900.

—— *Root Principles of Mine Ventilation.* The author having described in a previous paper the Atkinsonian theory of mine ventilation, taking as an example a mine with six unregulated splits, points out that a mine without regulators is an ideal rarely met with, and in his present contribution deals with the question of regulators. 6½ cols.—*Coll. Guard.*, May 25th, 1900.

6. Miscellaneous.

Electricity Applied to Mining.—*Electricity at Cripple Creek.* The article deals with the development of Cripple Creek, the famous gold mines of which are contained within an area of a little over six square miles, in which limited space there are upwards of 150 mines shipping gold, 15 of them having an output of 1,000 tons of ore each per month. The gold production of this district has grown from $200,000 in 1891, to $14,000,000 in 1898, and electricity has done much for the rapid development of these mines. Probably no other mining district is so thoroughly supplied with electricity. The home of the miner is lighted with incandescent lamps, he goes to his work in an electric street car, by an electric hoist he descends into the mine, electric lamps furnish illumination for his work, electrically driven pumps keep the mine dry, electric air compressors run drills, electric hoists raise the ore, and by electricity the blasts are fired from switch boards remote from the point of explosion. 1½ col.—*Mines and Minerals*, May, 1900.

Electrical Applications.—*Electricity in Mining.* By R. B. Williamson. The author deals with the principles governing the calculation, construction, and operation of electrical installations, explains the electrical units, circuits, resistances in series and multiple, electric wiring, conductors, sizes of wires, carrying capacity of cables &c. 5½ cols.—*Mines and Minerals*, May, 1900.

Cement Mining.—*Plant of the Lawrence Cement Company of Pennsylvania.* The article gives a full description of this important plant which is distinguished by many new and improved features in the arrangement of the machinery, and the hauling of materials. (Ill.) 8 cols.—*Engrg. Rcd.*, May 12th, 1900.

Cement Tests.—*The Manipulation of Cement Tests.* Digest of the report of the committee of the American Society of Civil Engineers on the proper manipulation of tests of cements, printed in the Society's Proceedings for April, 1900. 4½ cols.—*Engrg. Rcd.*, May 5th, 1900.

Manganese Mining.—*The Manganese Ores of Brazil.* By Herbert Kilburn Scott. Abstract of a paper read before the Iron and Steel Institute, May, 1900, in which the author gives a very full account of the manganese deposits of Brazil, their history, their character and their working. (Ill.) 7 cols.—*Coll. Guard.*, May 18th, 1900.

—— *The Manganese Ores of Brazil.* By Herbert Kilburn Scott. The author describes the great manganese deposits in the neighbourhood of Ouro, Preto, Brazil, extending over a distance of 5 miles. 4½ cols.—*Iron and Coal Trds. Rev.*, May 18th, 1900.

MUNICIPAL ENGINEERING.

1. Gas Supply.

Gas Lighting.—*The Calorific Power of Illuminating Gas.* By Harold G. Colman. The article deals mainly with the construction and efficiency of a calorimeter devised by Mr. Junkers, of Dessau, of which the author says that it offers a quick and accurate method of ascertaining the calorific power of gases. 11 cols.—*Journ. of Gas Lighting*, May 8th, 1900.

—— *The Incandescent Gas Mantle and its use.* By Prof. Vivian B. Lewes. Abstract of the Cantor Lecture delivered before the Society of Arts, May 7th, 1900, in which the author gives a popular account of the construction and use of incandescent gas mantles. 6½ cols.—*Gas Wrld.*, May 12th, 1900.

—— *The Incandescent Gas Mantle and its use.* By Vivian B. Lewes, F.I.C., F.C.S. This is the first of a course of three Cantor Lectures, by the chief superintending Gas Examiner to the Corporation of London, delivered at the Society of Arts, May 7th, 1900. 5 cols.—*Journ. of Gas Lighting*, May 15th, 1900.

—— *The Incandescent Gas Mantle and its use.* By Vivian B. Lewes, F.I.C., etc., Chief Superintending Gas Examiner to the Corporation of London. Second of three Cantor Lectures delivered at the Society of Arts, May 14th, 1900. (Ill.) 3½ cols.—*Journ. Gas Lighting*, May 22nd, 1900.

—— *The Kitson Light.* Description of a system of high-power lighting which has attained considerable success in the United States, and is now being introduced also in this country, its essential feature being the incandescence of a refractory mantle by a flame produced from vaporized oil contained in a closed vessel under air-pressure. (Ill.) 1¼ col.—*Mec. Engr.*, May 1st, 1900.

—— *The Paris International Exhibition. The Gas Pavilion. The Lighting.* The article deals with the premises devoted to exhibits of gas manufacture and gas-lighting and to the exhibits, as well as to the arrangements for electric lighting. 3½ cols.—*Journ. Gas Lighting*, May 22nd, 1900.

Water Gas.—*The Manufacture and Application of Water Gas.* By Carl Dellwik. Abstract of a paper read before the Iron and Steel Institute, May, 1900, giving a short review of the development of the manufacture of water gas and a description of the Dellwik-Fleischer process and its advantages. 4½ cols. (Ill.)—*Coll. Guard*, May 11th, 1900.

—— *On the Manufacture and Application of Water Gas.* By Carl Dellwik. The author, after a short review of the history of the manufacture of water gas, explains the theory on which the Dellwik-Fleischer process is based and the result obtained in practice, and enumerates some of the applications. (Ill.) 5¾ cols.—*Iron and Coal Trds. Rev.*, May 11th, 1900.

—— *The Manufacture and Application of Water Gas.* Abstract of a paper by Mr. Carl Dellwik. The author gives a short interim of the history of water gas production, of the new, simple and efficient apparatus, the effect of different methods of production, the result obtained by the Dellwik-Fleischer process, &c. (Ill.) 6 cols.—*Gas Wrld.*, May 12th, 1900.

2. Sewerage.

Sewage Disposal.—*Burslem, Stone and Willenhall Sewage Disposal.* Report by Dr. G. Reid, Staffordshire County Medical Officer. The report deals with experiments made in experimental plants constructed at the existing outfall works of the three authorities to test the efficiency of certain biological methods of disposal in the cases in operation, and carried on for periods of about 12 months. (To be continued.) 2 cols.—*Public Health Engr.*, May 12th, 1900.

3. Streets and Pavements.

Street Building.—*Report on the Laying out of the "Karlsplatz" at Vienna.* Summary of a lecture by Prof. Karl Mayreder, Architect. The lecturer deals with the completed and designed improvements of a very fine square in the city of Vienna. (Ill.) 3½ cols.—*Ztschrft d. Oest. Aug. u. Arch. Ver.*, April 27th, 1900.

4. Water Supply.

Water Analysis.—*The Analysis of Water and Sewerage.* Digest of a volume by Sidney Barwise, M.D., published by Rebman, Ltd., Shaftesbury Avenue, London, W.C., describing some special apparatus designed by the author and constructed by Messrs. Southall Brothers and Barclay, Ltd., Birmingham, giving at the same time complete instructions for the full sanitary examination of water and sewage affluents. 1½ col.—*Publ. Health Engr.*, May 12th, 1900.

Water Pipes.—*Device for preventing the bursting of Water Pipes from Frost.* The article summarises a communication recently made to the Franklin Institute of Philadelphia, by Mr. Nevil Monroe Hopkins, who describes a pneumatic device invented by him for the prevention of the bursting of water pipes from frost. ½ col.—*Génie Civil*, May 5th, 1900.

Water Purification. — *Water Purification at Vincennes, Ind.* Description of a mechanical filtration plant, combining coagulation, subsidence and filtration at Vincennes, Ind., U.S.A., the most notable features of which are the comparatively long periods of subsidence, the automatic control of the inflow and outflow of both the tanks and filters and the use of air in place of rakes for agitating the filtering material during the process of washing. (Ill.) 4 cols.—*Engng. News*, May 3rd, 1900.

Waterworks.—*The Failure of the Stand Pipe at Elgin, Ill., U.S.A.* By Wm. D. Pence, M.Am., Soc. C.E., Professor of Civil Engineers, Purden University, Lafayette, Ind. The author discusses the causes that led to the failure of the 30 × 95 ft. street stand-pipe at Elgin, Ill., which burst and fell about 8 a.m. on March 14th, 1900, and comes to the conclusion that the specifications were faulty in the tests for plate metal and that improper material was used; that the working strains in the plate metal were excessive; that failure would probably have occurred even with first-class material, owing to the exposure of the structure to the elements in an icy latitude; that the primary cause of the accident was the fall of ice, due to improper control of the water level during the critical ice period. 7¼ cols.—*Engrg. News*, May 3rd, 1900.

—— *Filtration of the Washington Water Supply.* About two years ago Congress made appropriation of $3,000 to enable the engineer officer in charge of the Washington Aqueduct and the chief of engineers, U.S.A., to investigate the feasibility and propriety of filtering the Washington water supply. About a year later Congress appropriated $5,000 more for this purpose. The investigation was recently completed, and a few weeks ago Gen. John M. Wilson, Chief of Engineers, transmitted Col. Miller's report to the Secretary of War, with his concurrence in the general conclusions. The present article gives a digest of this report. 4⅝ cols.—*Engrg. Rcd.*, May 12th, 1900.

—— *Report on Water Purification Experiments at Washington, D.C.* Digest of the report describing the results of the experimental purification plant established at Washington, D.C., about a year ago, to investigate the feasibility and propriety of filtering the water supply of that city. 6½ cols.—*Engng. News*, May 17th, 1900.

—— *Progress of the New Waterworks for Cincinnati, O.* The article deals with some special features of the waterworks of Cincinnati designed to pump water from the Ohio river at California, O., U.S.A., to settling basins from which it will flow by gravity to filters and clear water reservoir, and thence to a pumping station in the city. The intake, being located very near to the Kentucky shore, necessitated an intake pier in the river from which a tunnel 7 feet in diameter and 1,425 feet long extends to the pumping station on the Ohio shore. 1½ col. —*Engng. News*, April 26th, 1900.

5. Miscellaneous.

Garbage Destruction. — *The Thackeray Garbage Furnaces at San Francisco, Col., U.S.A.* The Company which obtained the contract for the garbage destruction of San Francisco adopted the Thackeray system of incineration in use at Montreal, and in 1897, under the supervision of Mr. Chas. Thackeray, was begun the construction of the furnaces which were completed the next year at a cost of about $75,000. A test run of 30 days under the direction of the municipal and health authorities, during which about 800 cubic yards of garbage was disposed of each 24 hours, proved very satisfactory. The present article describes fully the details of the installation. 5½ cols.—*Engng. News*, May 17th, 1900.

Municipal Government. — *Paris from a Hygienic Standpoint.* Summary of a lecture by Mr. Hermann Beraneck, Building Inspector, giving a concise review of the hygienic organisation of Paris, based partly upon the author's direct inspection and partly upon official and other reliable documents. 9 cols.—*Ztschrft d. Oest. Ing. u. Arch. Ver.*, April 27th, 1900.

New Market.—*The Great Central Railway and Portman Market.* The article describes the facilities offered to London inhabitants by the opening of the New Portman Market in connection with the Great Central Railway; this market is 4½ miles from Billingsgate, 3½ from Smithfield, and nearly 2½ from Covent Garden, and almost within a stone's throw from the Great Central Station. (Ill.) 1 col.—*Railw. News*, May 26th, 1900.

Refuse Destroyers. — *The Economical Disposal of Town Refuse.* Abstract of a paper by Mr. Brierly Denham Healy, read before the Society of Engineers, May 7th, 1900, in which the author explains the various systems adopted for burning refuse and of utilising the heated gases so as to make the process economical. (To be continued.) 7 cols.—*Publ. Health Engr.*, May 26th, 1900.

NAVAL AND MILITARY ENGINEERING.

Ballooning. — *Preliminary Trials of Long-Distance Ballooning.* The article deals with experiments made, and to be made, with the object of verifying the possibility of constructing a balloon or air-ship capable of remaining in the air for a long space of time without requiring a new charge of gas. (Ill.) 6½ cols.—*Revue. Techn.*, May 10th, 1900.

German Navy.—*The Progress of the German Navy.* An article dealing in a very important way with the impending increase of the German Navy and pointing out that within half a century, of which the first 20 years were not favourable to its development, Germany will have created a navy of the first rank and a merchant marine the second in rank of all the merchant fleets of the world. 3½ cols.—*Le Yacht*, May 12th, 1900.

—— *The German Ironclads, Brandenburg Type.* Short description of the *Kurfürst Friedrich Wilhelm*, which, with the *Brandenburg*, the *Weissenburg* and the *Woerth*, constitutes a group of four ironclads of the first order; the dimensions being: length 116 m., width 21 m., draught 8 m., displacement with 750 tons of coal on board 10,280 tons, 1½ col.—*Le Yacht*, May 12th, 1900.

Guns.—*Modern Field Artillery.* (Continuation.) The present instalment deals with further products of the Schneider-Canet Works, *i.e.* a 75-millimetre (2·952 in.) gun, long type, on carriage with independent axle; 75-millimetre (2·952 in.) gun, long type, on carriage with spade in a line with the axle; a 75-millimetre (2·952 in.) gun, heavy type, on carriage with front spade; a 75-millimetre (2·952 in.) gun, long type, on carriage with independent axle, and spade in line with axle; a 75-millimetre (2·952 in.) gun, long type, on carriage with inclined slide and spade beneath axle; an 80-millimetre (3·149 in.) gun, on carriage with trail spade and also Schneider-Canet gun on carriage with compressible trail. (To be continued.) 6½ cols. (Ill.)—*Engrg.*, May 4th, 1900.

—— *Modern Field Artillery.* (Continuation.) The present instalment contains the description of guns of the Schneider-Canet system, and is devoted to the 75-millimetre (2·952 in.) gun, long type, on carriage with trail spade and hydraulic recoil cylinders. (Ill.) 1½ col. (To be continued.)—*Engrg.*, May 11th, 1900.

—— *The Genesis of the Magazine Shoulder Gun.* The article describes a most remarkable discovery, namely a breech-loading machine gun with flint lock, constructed

by John Cookson, an Englishman, in the year 1586; it has a capacity of ten rounds and a magazine fitted to the lock holds a similar number of charges, being constructed to fire spherical bullets weighing 260 grains, with a charge of powder of about 125 grains. The old gun is a superb piece of mechanism and of excellent workmanship. It is at present in possession of Mr. A. E. Brooks, Hertford, Conn., U.S.A. (Ill.) 3⅜ cols.—accompanied by an editorial of 1¼ cols.—*Am. Mach.*, May 17th, 1900.

Guns.—*Machine Guns of Calibre.* The article deals with "machine guns of calibre," *i.e.* with guns throwing an explosive shell, whose weight is such as to be in conformity with the St. Petersburg Declaration of 1868, which enjoined that no explosive projectile less than 14 ozs. in weight would be tolerated in modern warfare. The maxim 1-pounder machine gun, more familiarly known as "Pom-pom," is the first machine gun of calibre ever used in the field, and its shell has a weight just sufficient to allow of the narrowest margin permissible by the clause alluded to in the St. Petersburg Declaration. 2 cols.—*Engr.*, May 11th, 1900.

—— *Manufacture of Guns and Armour at the Bethlehem Steel Works.* The article deals with the open hearth process employed in the famous Bethlehem Steel Works, which is one of the, if not the most, complete plants devoted almost exclusively to the manufacture of guns and armour. (Ill.) 3½ cols.—*Sci. Am.*, May 19th, 1900.

Navies.—*The Imperial Japanese Navy.* By Rear-Admiral C. C. P. Fitzgerald, A.F.N.A. The author, who has lately returned from Japan and had the opportunity of seeing some of the ships and dockyards of that country, comments in a very interesting manner on a few important facts and figures connected with the subject. (Ill.) 6 cols.—*Mar. Engr.*, May 1st, 1900.

Submarine Boats.—*The use of Torpedo Boats and Submarine Boats.* The author maintains that as regards torpedo-boats France is in an exceptionally favourable position and that the French engineer, M. Normand, has constructed the finest torpedo-boat in the world, and that the torpedo-boat destroyer, type "*Hallebarde*," are equally excellent as regards their kind of war vessels. He further insists on the great efficiency of submarine boats, of which France has the only specimens of real practical value. The United States have, it is true, he says, the *Holland*: this boat, however, is hardly beyond the experimental stage, while France has already these submarine boats in active service, *i.e.*, the *Gymnote*, the *Gustave Idá*, and the *Morse*, while eight more are to be added shortly. 3½ cols.—*Le Yacht*, May 5th, 1900.

—— *Submarine Navigation.* The article deals with the very complex, and by no means solved, problem of steering a submerged boat, and of determining its course. 7¾ cols.—*Revue. Techn.*, May 10th, 1900.

War Vessels.—*New Battleship Plans Completed.* On May 8th Secretary Long approved the circular prepared by the United States Board on Construction containing the specifications for the battleships *Pennsylvania*, *New Jersey*, and *Georgia*. The article gives the main provisions of this circular concerning the construction and equipment of the vessel. 1½ col.—*Naut. Gazette*, May 10th, 1900.

—— *Construction of the Cruiser "Varese."* The article describes the construction of the Italian cruiser *Varese* at the shipyard of Orlando Brothers, at Leghorn, a vessel having a length between perpendiculars of 104·8 m. and a width of 18·2 m. and a displacement of 7,508 tons. (Ill.) 2½ cols.—*Le Yacht*, May 26th, 1900.

RAILWAY WORK.

1. Motive Power and Equipment.

Air Brakes.—*Lubricating Air Brake Parts.* Extracts from a report presented at the Jacksonville meeting of the Railway Air-Brakemen by the committee appointed to inquire into the subject, and dealing with the lubricating of the pumps, the brake valve, triple valves, brake cylinders, drawer brake cylinders, and tender brake cylinders. 4 cols—*Ry. Master Mech.*, May, 1900.

Locomotives. — *Powerful-boilered Locomotives.* By Arthur E. Kyffin. The author describes various types of locomotives with very powerful boilers, dividing them into two classes, *i.e.* those that are built to take the place of the older type altogether and become the standard design, and those that are built for special services, and so far as possible used for such work alone. (Ill.) 3 cols.—*Mech. Wrld.*, May 11th, 1900.

Locomotives.—*Some Points about Steel Forgings for Locomotives.* Extracts from a paper on "The Standardising of Specifications for Locomotive Forgings," read before the North West Railroad Club, Chicago, U.S.A. 6 cols.—*Ry. Master Mech.*, May, 1900.

—— *The Standardising of Specifications for Locomotive Forgings.* By H. F. Porter. Abstract of a paper read by the author, a member of the Bethlehem Steel Co., before the North West Railroad Club, Chicago, and containing a number of valuable suggestions on the subject. 7¼ cols. —*Ry. Master Mech.*, May, 1900.

—— *The Heaviest Passenger Locomotive ever built. Delaware, Lackawanna and Western R.R.* Until recently a ten-wheel locomotive of Lake Shore and Michigan Ry. was the heaviest locomotive ever built; it weighed, together with the tender, 283,600 lbs. But at present there exists a locomotive built for the D. L. & W. R. R. by the Brooks Locomotive Works which, with its tender weighs 299,000 lbs. and 179,000 lbs. without the tender. The article fully describes the new machine, giving all essential data. 1⅜ col.—*Engrg. News*, May 10th, 1900.

—— *Brooks' Ten-Wheel Passenger Locomotive, L. D. & W. Ry.* Short description of a very handsome 10-wheel passenger engine, one of seven built by the Brooks Locomotive Works for the Delaware, Lackawanna and Western Ry. Co. (Ill.) ¾ col.—*Ry. & Eng. Rev.* May 5th 1900.

Railways.—*The Great Western Railway Company's New Corridor Train for the London and Cork Service.* Description of a specially-constructed train, distinguished by great elegance and comfort, a distinguishing feature being the corridor running through the midst of the carriages from one end to the other. (Ill.) 1⅜ cols.—*Railw. News*, May 26th, 1900.

2. New Projects.

Railways.—*Paris Exhibition Railways.* (Continuation.) The present instalment deals with the second section of the Exhibition line, extending from the Avenue du Trocadero station to the junction with the railway following the left bank of the Seine—the Molineaux line. (To be continued.) (Ill.) 4¼ cols.—*Engrg.*, May 4th, 1900.

3. Permanent Way and Fixtures.

Railways.—*Handling Long Freight Trains on Mountain Grades.* Digest of a Committee Report on "Successful handling of Passenger and Long Freight Trains," presented at the Jacksonville meeting of the Association of Railway Air Brake-men. 4⅜ cols.—*Ry. Master Mech.*, May, 1900.

Railway Signalling.—*Manual Controlled and Automatic Signals.* By Alexander Holley Rudd, Signal Engineer. The author deals very fully with the respective drawbacks and advantages of the two systems, and discusses the benefits of a combination of the two systems. 6 cols—*Engng. News*, May 10th, 1900.

Railway Ties.—*Tie Preservation in Europe.* Abstract of a paper by Octave Chaunte, read before the Western Society of Engineers, March 21st, 1900, in which the author gives some very interesting details regarding the means employed for the preservation of wood, notably such as is used for railway ties, in England, France and Germany. 3 cols.—*Ry. & Engrg. Rev.*, May 5th, 1900.

Steel Rails.—*Proposed Standard Specification for Steel Rails.* Summary of bulletins 8-18 of the American section of the International Association for Testing Materials, containing the report of the American branch of Committee No. 1, appointed to establish international rules and specifications for testing and inspecting iron and steel. 2 cols.—*Ry. & Engrg. Rev.*, May 12th, 1900.

Tunnels.—*The Building of the Simplon Tunnel.* By Mr. C. J. Wagner, Acting Director of the Imperial State Railways, Vienna. The author, referring to an address delivered in 1895, in which he discusses the project of the tunnel, describes in this address the progress of the work up to December, 1899. 17 cols.—*Zischrft. d. Oest. Ing. u. Arch. Ver.*, May 25th, 1900.

4. Transportation and Conducting.

5. Miscellaneous.

Railways.—*Railway Construction in India.* By Edward Waller Stoney, M.E., M.Inst.C.E., Chief Engineer, Madras Railway. The author gives a summary review of the railways of India, which now reach a length of 23,500 miles, of which 13,400 are of the standard gauge, 5ft. 6in., and the remainder, 10,100 miles, the most remarkable of the latter being the Darjeeling line of 2ft. gauge, 51 miles long, laid in the Hill Road, carrying a large traffic and paying its shareholders 10 per cent. dividends. (Ill.) 7 cols.—*Ind. & East Engr.*, April, 1900.

—— *French Railways and their Work.* By Charles Rous-Martin. In this, the sixth instalment of his contribution, the author deals with the latest improvements of the "Chemin de fer du Nord," which are proofs of great energy of the administration and mark a noteworthy progress. 3½ cols.—*Engr.*, May 11th, 1900.

—— *Smoke Prevention on Locomotives.* Extracts from the report of the committee of the Western Railway Club, U.S.A., charged with an inquiry into the best methods of smoke prevention, from which it appears that more attention is given to the subject and better results are reached in Chicago than in other Western cities. 1¾ col.—*Ry. Master Mech.*, May, 1900.

Railway Workshops.—*The Lancashire and Yorkshire Railway Workshops at Horwich.* Description of a very striking transformation and development of a large railway workshop, by Mr. J. A. F. Aspinall, C.E., at Horwich, where, in place of a small population of 4,000, one of 15,000 inhabitants has established itself within the brief period of thirteen years. (To be continued.) (Ill.) 6½ cols.—*Mech. Progress*, May, 1900.

—— *Through Siberian Railroad Shops—Notes on Practice and Machinery.* By L. Lodian, Paris, France. The author describes the plant and equipment of the more important railway shops on the Trans-Siberian Railroad, namely those at Nikolshi, Kabapofk, on the Amur, Chita, between the Jablori and Altai ranges; Ipkytch, the biggest of Siberian villages, about 60 versts from the great Baikal Lake, the shops in Western Siberia at Kpasnoiapsk, Omck, and Chelabinck, and Cipoctan, near the Asia-Europe dividing line obelisk. The contents of the contribution are better than the style, though both are of a rather eccentric nature. 7 cols.—*Locomot. Engrg.*, May, 1900.

STREET AND ELECTRIC RAILWAYS.

Electric Railways.—*The Central London Railway.* Description of the new electric railway, which promises to do so much towards relieving the congestion of London streets, and which, beginning at Shepherd's Bush, will ultimately be prolonged to Liverpool Street Station. There is also the project of a connection with the line now in course of construction from Baker Street to Waterloo. (Ill.) 2 cols.—*Ry. News*, May 12th, 1900.

—— *The Manchester and Liverpool Electric Express Line.* Description of a scheme of which Messrs. Hawkshaw and Dobson and Mr. Behr are the joint engineers. The intention is to use Behr one-rail system, and trains are to run at the rate of 110 miles an hour, covering the distance between Manchester and Liverpool within 20 minutes. The capital of the company would be £2,000,000 with power to raise £660,000 on debentures. 1¾ col.—*Ry. News*, May 12th, 1900.

—— *The Aussig Electric Street Railway.* Description of an electric street railway built by the municipality of Aussig, situated at the north-western terminus of the great Bohemian Crown coal deposits on the Elbe, which was opened to traffic July 1st, 1899, and comprises two lines, one having a length of 5·88 km. and the other a length of 1·37 km. (Ill.) 4¼ cols.—*Mitheil d. Ver f. d. Förderung d. Local u. Strassenbahnw.*, April, 1900.

—— *Tramway Cars for New Zealand.* Description of a number of tramway cars recently shipped by the J. G. Brill Company, which are of a remarkably small size, the body being 14 ft. long, the platforms 4 ft. long, giving a total length of 22 ft. A much larger car could be operated with little more power. 1 col.—*Tramw. and Ry. Wrld.*, May 10th, 1900.

—— *Southampton Corporation Tramways.* Short description of the complete Southampton Electric Tramway System, which is practically in working order and which developed from a private enterprise. The engineers of the enterprise were Messrs. Kincaid, Waller, and Manville, Westminster. (Ill.) 6 cols.—*Tramw. and Ry. Wrld.*, May 10th, 1900.

Electric Railways.—*Electricity in the Service of Railways.* By Mr. Frahm, Inspector of Railway Construction and Traffic. (Conclusion.) 12½ cols.—*Stahl u. Eisen.*, May 1st, 1900.

—— *Electric Tramways of Nice and of the Littoral.* The article deals with the modern motor car system inaugurated in Nice during the early Spring of the present year and with the whole tramway system on the Riviera which, measuring it as a single track, has an aggregate length of 90 miles. (Ill.) 5 cols.—*Tramw and Ry. Wrld.*, May 10th, 1900.

—— *Wilmerding and East Pittsburg Electro-Magnetic Railway.* Description of an electro-magnetic traction system installed by the Westinghouse Company between East Pittsburgh and Wilmerding, Pennsylvania, which differs from the double-contact system in that the contact buttons are installed in a single row, parallel to the track instead of in two rows. (Ill.) 1½ cols.—*West Elect'n.*, May 5th, 1900.

—— *From Canada to the United States by Trolley.* The article deals with the loop built along the Riverway, Niagara Falls, which is to form a connecting link between the Canadian and American tracks of the International Traction Company and which, within a few weeks hence, promises to become one of the busiest pieces of trolley track. 1 col.—*Tramw. and Ry. Wrld.* May 10th, 1900.

—— *Suburban Extension of Union Railroad Company at Providence, R.I.* The Union Railroad Company of Providence, R.I., U.S.A., operates the street railways throughout the city with a regular service of from 300 to 400 cars and has recently begun to extend its lines 18 miles into the country. The article describes the plant used for generating the alternating current supplied to the new line. (Ill.) 3½ cols.—*West. Elect'n.*, May 5th 1900.

—— *Accumulators on Trunk Lines in Germany.* Description of the success obtained in the operation of single cars for passenger service on steam railroads, by the use of accumulators and of the experiments made by the railway commissioners of the "Pfalz" and of Würzburg in Bavaria. 1¾ cols.—*Street Ry. Journ.*, May 1900.

—— *The Jungfrau Three Phase Electric Railway.* By W. H. Molesworth. The author, one of the engineers of the engine-works, Oerliken, describes this remarkable mountain railway, which ascends to a mountain top 4,167 metres above sea level and 12,600 metres above Interlaken. (Ill.) 7 cols.—*Street Ry. Journ.*, May, 1900.

—— *Surface Contact System at Monaco.* Description of a line 2·8 miles in length with a track width of 1 metre. The route is varying in character and in some places there is a gradient of 9 per cent. The contact blocks are in two rows between the rails and each block is placed about 300 mm. (1 ft.) from the nearest rail. There are six cars in operation. 2 cols.—*Street Ry. Journ.*, May, 1900.

—— *Electric Railway System of Halifax, N.S.* By E. M. Archibald. Description of an electric line having an aggregate length of 13·5 miles. Of interest are the devices to secure the working during periods of heavy snow-fall, For this purpose there are used three sweepers which carry three motors each, two for propelling power and one for driving the sweeping apparatus. (Ill.) 4 cols.—*Street Ry. Journ.*, May, 1900.

—— *The Ringsend Power Plant of the Dublin United Tramways Company.* By A. C. Shaw. Description of the new power station for the electric tramway plant at Dublin, which is second to none as regards extension and equipment, in the British Isles. The station contains five Corliss engines, each of which is direct-coupled with a 500 km. generator. Besides these are four motor-generators, or rail-return Coosters, three of 15 km. and one of 24 km. The boilers used are water-tube boilers with automatic-feeding apparatus. There are machines for the hauling of coals and economizers are in use. (Ill.) 15 cols.—*Street Ry. Journ.*, May, 1900.

Electric Railways.—*Dublin Electric Tramways* (Conclusion). Description of the site, the power, plant, the equipment, and the work of the trolley-wire system of Dublin, which includes a line also through Sackville Street, the chief street of the city. 4 cols.—*Elec. Rev.*, May 4th, 1900.

—— *The Dublin-Lucan Tramway.* Description of an electrical suburban line which has replaced a former steam line and has a length of 7½ miles. The power station is distinguished by a novel arrangement of the boiler-room, which is open to the air and thereby an easy ventilation is secured. (Ill.) 2 cols.—*Street Ry. Journ.*, May, 1900.

—— *The Electrical Equipment of the Waterloo and City Railway, London.* By Bernard Maxwell Jenkin. Abstract of a paper by the author, read before the Institution of Civil Engineers, describing the electrical equipment of a railway, the construction of which has been completely described in a paper by Mr. H. H. Dalrymple-Hays. (Ill.) 6 cols. (To be continued.)—*Mech. Wrld.*, May 25th, 1900.

—— *The Mono-Rail Suspended Railway of Barmen-Elberfeld.* The article deals fully with this peculiar type of electrical railway, which promises to become popular as a means of communication between places not very far apart from each other if the present experiment proves successful. (Ill.) 6¼ cols.—*Tramw. and Ry. Wrld.*, May 10th, 1900.

—— *Improvements in the Field of Local and Street Railways.* The article describes—(1) several types of electrical locomotives built by the "Union" Electrical Society of Berlin; (2) a steam auto-mobile, System of Valentin Purrey, of Bordeaux; (3) new types of gas-motor wagons, system Lührig in use on the tramway lines of the Blackpool, St.Annes, and Lytham Co., and on the Trafford Park Tramway Line at Manchester. (Ill.) 4⅞ cols.—*Mitheil d. Ver f. d. Förderung a. Local u. Strassenbahnw*, April, 1900.

—— *Operation and Maintenance of Street Railways.* By H. F. M'Gregor. Abstract of a paper read at the Annual Meeting of the South Western Gas, Electric, and Street Railway Association, Ware, Texas, U.S.A., April 13th, 1900, containing various observations growing out of the author's experience. 2½ cols.—*Electricity* (New York), May 9th, 1900.

—— *The Tests of Train-Unit Controlling Systems in the Boston Subway.* Description of a series of competition tests carried on during the month of April by the Boston Elevator Railroad Company, in order to decide which make of apparatus to use for the equipment of the trains of its new elevated lines. There were three systems in the competition, the Sprague results per unit, the Westinghouse electro-pneumatic, and a new quarter-controller system of the General Electric Company. These tests are reported to have cost the Boston Elevated Company about $20,000, and must have cost the three competitors about $18,000. 5 cols.—*Street Ry. Journ.*, May, 1900.

—— *Number of Cars Required on a Given Length o Track at Various Speeds and Headways.* By H. C. King. The author gives a diagram for quickly ascertaining the number of cars required to give a specified headway on a given length of track at any required speed in miles per hour. 1 col. *Tramw. and Ry. Wrld.*, May 10th, 1900.

—— *The Application of Electric Traction to Existing Railways.* By Ed. C. Segundo, Ass. M. Inst. C.E. (Conclusion.) 3 cols.—*Elec. Rev.* (London), May 18th, 1900.

Traction.—*Road Locomotion.* By Prof. H. S. Hele-Shaw, LL.D., F.R.S. Abstract of a paper read by the author before the Society of Mechanical Engineers, in which he discusses the general principles of the engineering features of the question, rather than giving a detailed description of any particular system. 9½ cols. and 7 cols. respectively.—*Cont. Journ.*, May 2nd, 1900.

—— *A New System of Multiple Unit Control.* Description of an experimental method of control adopted by the Boston Elevated Railway Company in connection with the Westinghouse system, consisting of an electric pneumatic system containing a standard controller, to which are attached compressed air cylinders fitted with pistons and suitable operating gearing for moving the controllers stage by stage in starting and running the train, and to return the controllers to the "off" position. Similar cylinders, also operated by compressed air, reverse the controllers, so that the train may be moved at will in either direction. 2½ cols.—*Elec. Rev.*, May 2nd, 1900,

TRADE AND ECONOMICS.

1. Commerce and Trade.

Cotton Industry.—*Cotton Supplies.* Abstract of a paper by Mr. John A. Bannister, read before the Society of Arts on April 4th, 1900. The author of this very interesting paper points out the impossibility of treating adequately so important a subject in a single paper, but adds that confining himself to a portion merely of the important question, he is making no statement that he has not been at the greatest pains to verify. (To be continued.) 4½ cols.—*Textile Recorder*, May 15th, 1900.

Industrial Progress.—*Statistics of Industrial Production in the German Empire.* Extract from the official statistics published by the German Government regarding the condition of German industries during the year 1897. 5 cols.—*Stahl u. Eisen*, May 1st, 1900.

Salt Deposits.—*The Salt Wells of Sachuan, China.* By W. M. Upcraft. Description of a very interesting sight in the Chinese province named, and one of the most important industries carried on there; the brine being evaporated over flames of natural gas. (Ill.) ⅔ col.—*Engrg. and Min. Journ.*

2. Currency and Finance.

3. Government Control.

4. Labour.

Factory Work in America.—*Factory Conditions in the South To-day.* Summary of a very instructive address delivered by President George Gunton, of the New York Institute of Social Economics, on the condition of the cheap mountain labour employed to operate the new cotton mills in the South of the United States. The author describes a most deplorable condition of things. White women and children from the age of seven and even below that—there is no limit—are doing the work on wages less than half of those paid even in the worst factories of New England. The machinery is of the most modern and improved type, requiring no skilled labour whatsoever. The work goes on night and day, there being no laws limiting the hours of labour. The owners make enormous profits, and can of course easily compete with the New England manufacturers. In fact they are gradually absorbing the whole trade. So that the question is, shall New England go down, shall the labourers of New England and the whole conditions of social life of New England operatives go down, or shall the conditions of Southern labourers go up? 3 cols.—*The Bulletin of the Am. Iron and Steel Assoc.*, May 1st, 1900.

5. Miscellaneous.

Colour Photography.—*The Ives System of Colour Photography.* The article describes various apparatus, among them the "Kromskop" and "Kromskop Camera" devised by Mr. Frederic E. Ives for the purpose of showing in stereoscopic form and natural colours photographed objects. The basis of the invention is the use of coloured glass. (Ill.) 2½ cols.—*Sci. Am.*, May 5th, 1900.

Gutta-Percha.—*Substitutes for India-rubber and Gutta-percha for Electrical Purposes.* The article deals with various compounds, of which the author says that they are equally as efficacious as pure gutta-percha for many of its applications, and one of which is a continuation of gutta-percha and waste products. 2½ cols.—*Electro-Chem. Rev.*, May, 1900.

RECENT CATALOGUES.

Alternating Current Switchboards; for Polyphase Circuits. Type 6, 100-600 volts; 1,100-2,200 volts; Type 8, 100-600 volts; 1,100 or 2,200 volts; Standard Railway Switchboards, Type 5; D. C. Lighting and Power Switchboards, Type 5, Potentials not exceeding 750 volts; Direct-Current Switchboards, Type 7, 110-250 volts; Alternating-Current Fan Motors; Compensators for A.C. Circuits; Incandescent Street Lighting System.

The above are the titles of another batch of explanatory catalogues, issued by the British Westinghouse Electric and Manufacturing Co., Ltd., Norfolk Street, Strand, London, E.C., numbered 1,018-1,027 inclusive, and giving a very lucid and full description of the great variety of apparatus dealt with and manufactured by this famous concern. They are accompanied by a small pamphlet consisting of extracts from the Presidential Address delivered by Professor Silvanus P. Thompson before the Institution of Electrical Engineers, emphasising the "great and inherent superiority" of alternating over continuous currents; thus indirectly endorsing the speciality of alternating current generators and accessory apparatus for which the Westinghouse Company is celebrated.

Bailey's Pumps and Hydraulic Machinery and Bailey's Useful Inventions for Engineers. W. H. Bailey and Co., Ltd., Albion Works, Salford, Manchester.

Two big volumes excellently printed and illustrated, and bound in solid but attractive style, deal with specialities manufactured by Messrs. W. H. Bailey and Co. The first, comprising 377 quarto pages, is especially devoted to the Davidson Steam Pumps, Duplex Steam Pumps, Flywheel Steam Pumps, Waterworks Pumping Engines, Aqua-Thruster Pumps, Boilers, Injectors and Ejectors, Testers for Pipes and Cement, Valves, Governors, &c., Tide Gauges, Colliery and Chemical Works Pumps, Air Pumps, Hand Pumps, Air Compressors, Water Motors, Hot-Air Engines, Hydraulic Lifts, Cranes, Hydraulic Presses, and Pumps and Recorders for Speed, Pressure and Depth. The fullest data are given of dimensions and speed, and in the majority of cases prices are mentioned, subject, of course, to alterations. The second volume, which is No. 1 of the Sectional Catalogues of the firm, describes a great variety of valves, cocks, pressure gauges and recorders, pyrometers and steam thermometers, steam traps, roarers, whistles, and bells, water-heaters, fire fittings, &c., manufactured at the Albion works. Most of the illustrations are splendidly executed woodcuts from photographs, and the whole general appearance, as well as the contents of the two volumes, do high credit to Messrs. W. H. Bailey and Co., who, as may be incidentally mentioned, are specially appointed makers to the Admiralty, War Office, and India Office, of steam engine and boiler fittings, asbestos packed fittings, torpedo boat fittings, pumps, testing machines, &c.

Husson's Safety Acetylene Lighting. Husson's Safety Acetylene Syndicate, Victoria Mansions, 28, Victoria Street, Westminster, London.

The catalogue published under the above title describes a potential acetylene generator of Swiss invention, which, in addition to great safety and reliability, has the decided advantage of simplicity, and obtained the "Highest Award" at a National Exhibition in Switzerland last year, where it figured among generators. It is undoubtedly a great improvement on other types of acetylene generators in so far as its construction removes the sources of danger existing in their being hermetically closed. In Husson's generator the hopper at the top through which the carbide is introduced remains always open. After the generator is filled with water and the carbide thrown into it the water prevents the gas escaping except through the channel that leads into the holder, so that there is at no time stored up gas which may become a cause of explosion. Of almost equal value is the facility with which the apparatus can be cleansed and recharged, so that its management may be left to any person gifted with common sense, and requires no special knowledge.

The "British" Roller Bearings. The Roller Bearings Co., Ltd. London offices: 1, Delahay Street, Westminster, S.W. Works: King's Lynn.

The catalogue describes a type of roller bearings for which is claimed (1) Great reduction in starting and running effort, which means, of course, great economy in working expenses; (2) Saving in lubrication; (3) Economy in maintenance. The testimonials published at the end of the pamphlet, and the fact that these bearings have been in use for some time on various great railway systems, certainly endorse the claims made by the manufacturers in an indisputable manner.

Catalogue of Machine Tools. 1900. George Swift. Claremont Ironworks, Halifax, England.

The firm of George Swift makes a speciality of the manufacture of drilling machines, and the satisfactory character of these machines is proved by the fact that Mr. Swift has a short time ago increased his works to twice their original extent, and put down a special plant for slotting machines. Customers are informed that machines can be supplied with machine-cut gearing throughout, or having the principal wheels only machine-cut.

Abridged Illustrated Catalogue of Machine Tools. Geo. Richards and Co., Ltd., Broadheath, near Manchester; and Société

Continentale Richards, 16, Place de la Republique, Paris.

Messrs. Richards and Co. have published the above-mentioned catalogue in connection with their exhibits at the Paris Exhibition, British Section, Group 4, Class 22. It contains a description, accompanied by clear woodcuts, of a selection of types of machine tools, pattern making machinery, air compressors, pulleys, and line shaft fittings manufactured at their works, and gives full data of weights and dimensions, accompanied by prices.

Machine Tools. Webster and Bennett. May, 1900. Coventry, England.

Messrs. Webster and Bennett, whose first supplementary catalogue has been mentioned in our November issue, have published a second one this year, bringing up the description of quite a variety of machine tools manufactured at the Atlas Works, West Orchard, Coventry, up to date. This catalogue, like the previous one, is well illustrated, and gives all the most important dimensions and details, but other particulars will be furnished if desired. A notice informs the reader that "metric lead screws" can be provided to lathes to order.

Machine Tools. Atlas Tool Works, Levenshulme, Manchester, England.

The above is the title of a catalogue published by the Atlas Engineering Co., describing a number of machine tools, among them the "Empire" sliding, surfacing and screwcutting lathe, break lathes, the Universal Radial Drilling Machine, and the "Gardner" Horizontal Boring Machine, a 12 in. slotting machine, planing machines and milling machines. The most important dimensions are given, and the description is accompanied by engravings.

Pillatt's Patent Combustion Stationary Furnace. A. E. Pillatt (late A. Pillatt and Co.), Queen's Road Works, Nottingham.

This is a small booklet printed in blue type, describing an invention patented in 1895, but considerably improved since that date. This invention consists in a furnace, the basis of which is a chilled iron bar cast hollow, longitudinally, with a provision of lateral openings, which renders possible a regulated and sufficient supply of hot air directly drawn from the ashpit and delivered superheated at the back of the bridge. This bridge is so contrived as to deflect superheated air, which at once combines with any combustible gases given up by the fuel, and not burned on the grate, causing a flame to burst forth which totally consumes all smoke. The makers claim for their furnace that it secures a substantial and direct economy by the use of the additional heat derived from the consumption of the combustible gases, and a great number of testimonials reproduced at the end of the little catalogue support the statements made by the makers.

Delta Metal. The Delta Metal Company, 110, Cannon Street, London, E.C.

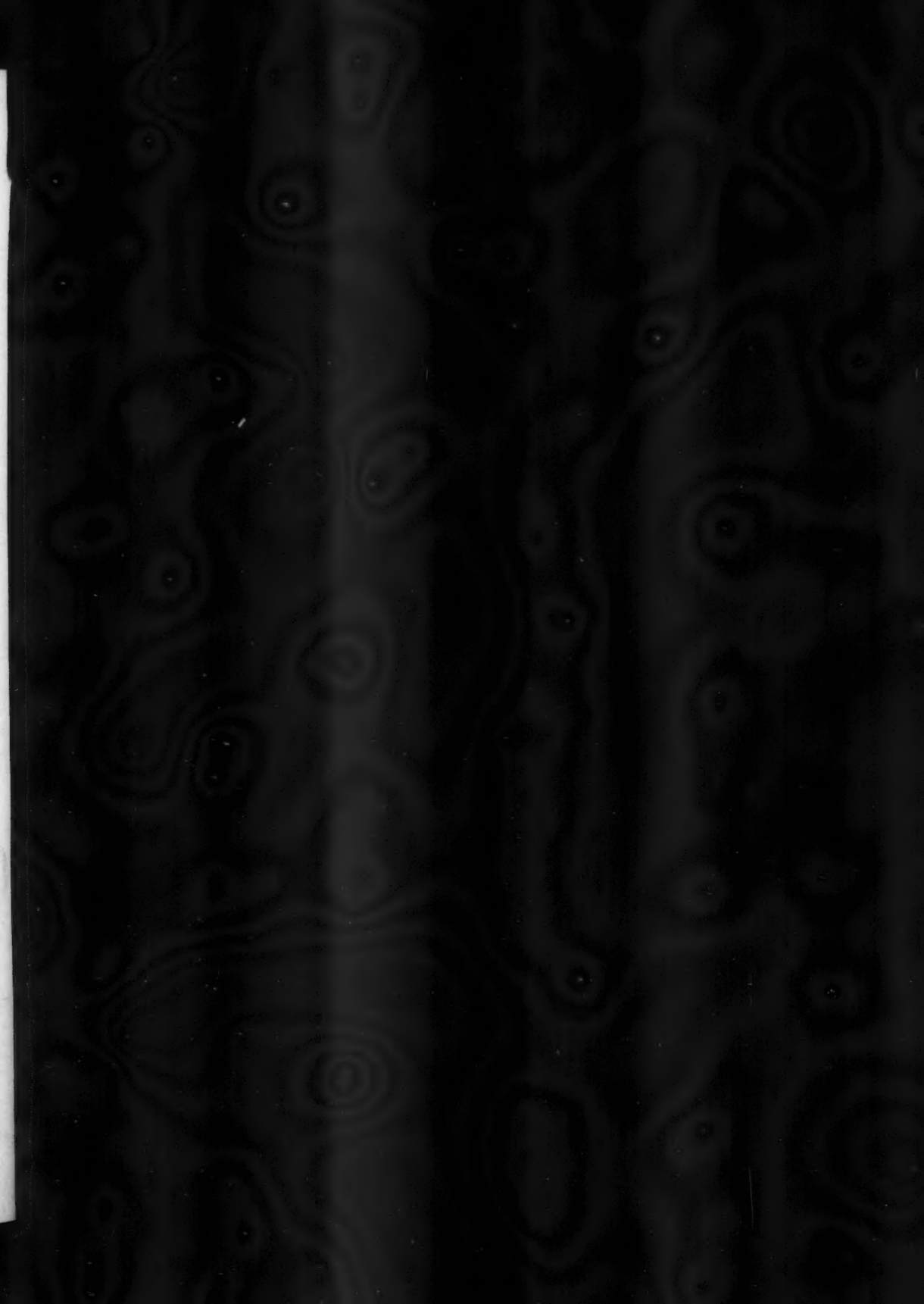
The alloys produced by the Delta Metal Company, Ltd., and sold under the name of "Delta" and "Delta Metal," vary in composition according to the requirements of the different purposes for which each of these alloys is more particularly suitable. Some of them possess in a very high degree the properties of malleability, strength, and resistance to corrosion; others are superior "bearing" metals; others again have particular qualificatious for electrical purposes, but each alloy has special points to recommend it. The catalogue published by the Company, under the title quoted, deserves undoubtedly the attention of manufacturers and engineers.

Green's Economizer. E. Green and Son, Ltd., 2, Exchange Street, Manchester.

We have already noticed, in the first issue of our magazine, Green's Economizer for utilising the waste heat from steam boilers, and can only repeat that the extraordinary increase in the number of those who avail themselves of the apparatus is a sufficient testimony to its excellence. As regards the catalogue published by Messrs. E. Green and Son, it may be said that it is an extremely attractive publication, both as regards contents and general appearance. The printing and illustrations are worthy of an invention that has made its way not only over Great Britain and the Continent, but is, to quote the catalogue, "as well known in the spinning mills of Russia and India as in the numerous manufactories of the United States of America and Canada, and is equally noted among the gold mines of South Africa, as in the textile factories of China and Japan."

Warming and Ventilation. Ashwell and Nesbitt, Ltd. Head Office: 12, Great James Street, Bedford Row, London, W.C.

The catalogue published by the firm abovenamed is a most beautiful specimen of the printer's art, and presents to the reader in a very alluring form the work done by Messrs. Ashwell and Nesbitt, which, as the "List of Places" mentioned in the text shows, extends over a very wide area. The descriptive portions are concise, but lucid, and the illustrations show the general character and extent of the buildings supplied with the firm's heating and ventilating apparatus.

The "Reeves" Patent Filters for the Purification of Water. Sole Licensees: Mather and Platt, Ltd., Salford Iron Works, Manchester.

The catalogue published by the owners of the "Reeves Patent" gives a short outline of the various installations of the filtering plant, accompanied by very fine illustrations. Intending customers will find the reading matter interesting and instructive, and will realise from the text the importance of the firm, as far as its specialty is concerned.